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US EPA Region 8
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Submitted by:
Atlantic Richfield Company
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Initial Solids Removal Plan

Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01 Rico, Colorado

Atlantic Richfield Company

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Mr. Steven Way
On-Scene Coordinator
Emergency Response Program (8EPR-SA)
US EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: Initial Solids Removal Plan
Rico-Argentine Mine Site – Rico Tunnels
Operable Unit OU01 Rico, Colorado

Dear Mr. Way,

Please find enclosed three (3) copies of the revised *Initial Solids Removal Plan*, including a memorandum with responses to specific comments as Appendix E, both dated June 30, 2011; in addition, an electronic copy of the combined documents in PDF file format is being submitted via email. Atlantic Richfield is submitting the revised document and response to comments pursuant to comments received from EPA by email dated May 27, 2011, and in accordance with the Removal Action Work Plan, Rico Project – Rico Soils and St. Louis Ponds Rico, Colorado dated March 9, 2011.

If you have any questions, please feel free to contact me at 406.491.1129.

Sincerely,

Chuck J Stilwell

Chuck Stilwell, P.E.
Project Manager
Atlantic Richfield Company

Enclosures

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1.0 Introduction

1.1 Purpose

This Inirial Solids Removal Plan (Plan) addresses the overall removal and drying of solids from all of the upper ponds at Operable Unit OU01 of the Rico-Argentine Mine Site – St. Louis Tunnel (Site) responsive to the requirements of Section 5.2.1 of the Removal Action Work Plan, Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01 Rico, Colorado dated March 9, 2011 (see Figure 1 for Site location). As described below, this Plan focuses on the near-term removal of solids at Pond 18 and construction and operation of an interim drying facility. This initial removal and interim drying of existing solids from Pond 18 will also provide field-scale data to evaluate the best means and methods for removal and drying of existing solids from the remaining upper ponds and also for management of future lime solids that are expected to be generated as part of the future water treatment system. A general plan and schedule for all initial solids removal is provided, but will be refined upon evaluation of the Pond 18 solids removal. This initial solids removal will result in the majority of existing pond solids being moved from the active settling ponds of the treatment system, and ultimately being placed in a secure on-site repository.

1.2 Scope

A substantial portion of the existing precipitation solids and sediments (hereinafter typically referred to as solids) in the upper ponds (Ponds 18, 15, 14, 13, 12 and 11 – from north to south) will be removed, dried, and eventually disposed of in a future on-site repository. The solids removal will begin in the summer of 2011 at Pond 18 and placement of solids in an on-site solids repository will be completed no later than December 2014 as described more fully in Section 5.0 below. An overall plan of the portion of the ponds system encompassing the upper ponds is shown in Figure 2.

The currently envisioned means and methods of removal and interim drying of Pond 18 solids are described in this Plan. The specific detailed methods utilized will be determined in the field based on: current site conditions in Pond 18 and at the interim drying facility site; weather conditions during the removal and interim drying period (precipitation, evaporafion and wind); performance of the equipment used for removal of sediments; and the performance of the interim drying facility.

An interim drying facility will be constructed in summer 2011 to allow drying and storage of the portion of the existing solids to be removed from Pond 18, pending construction of the planned on-site solids repository. The solids in the remaining upper ponds will be processed in the interim drying facility, or a permanent drying facility to be constructed together with the solids repository, depending on when they are removed.

The interim drying facility will be constructed with up to four (4) separate cells to facilitate full-scale testing of altemative drying methods and also provide information valuable to designing a permanent drying facility and establishing operational procedures. Data will be collected and observafions documented for the major elements of the removal and interim drying processes during the initial Pond 18 solids removal. The method of solids removal and drying will be modified for subsequent solids removal, as informed by the field experience gained during the Pond 18 removal this summer.

1.3 Precipitation Solids Inventory

Precipitation solids have accumulated in the upper ponds (Ponds 11-15 and 18) at the Site as a result of precipitation and settling of metal complexes by natural processes and by prior addition of lime to the St. Louis Tunnel discharge from approximately 1984 to 1995. It is also possible that some amount of sediment eroded from the floor of the underground workings in the St. Louis Tunnel and/or from the bed and walls of the open channel outside the tunnel have been conveyed by the St. Louis Tunnel discharges to Pond 18 and possibly to the other upper ponds.

An inventory of existing solids was performed in 2001[1] by precision surveying utilizing a sampling boat outfitted with a survey prism and depth sounding rods. The estimated volume of solids as of the time of the 2001 surveys in each of the upper ponds investigated is summarized as follows:

- Pond 18 – 20,000 cubic yards (see discussion below regarding current estimated volume)
- Pond 15 – 11,000 cubic yards (see discussion below regarding calcine tailings beneath solids)
- Pond 14 – 2,600 cubic yards
- Pond 13 – not inventoried (see discussion below with estimate of current solids volume)
- Ponds 11 and 12 – 10,600 cubic yards

A total in-place volume of 44,200 cubic yards (cy) of solids was estimated from the 2001 surveys and probing (not including material in Pond 13 or calcine tailings found at the bottom of Pond 15, and prior to the initial in-pond dewatering of solids in Pond 18, as discussed below).

Following the original survey of sediment volumes in 2001, water was re-routed around Pond 18 for a period of 10 months to allow the pond solids to dewater (as discussed in Section 1.4 below) and the solids were observed to consolidate in place. Also, a small volume of solids was removed for use in the pilot scale test cells in Ponds 16/17 in 2002. Water was again re-routed around Pond 18 in late fall 2010 and has continued to bypass the pond to present (approximately 7 months to date). Based on a recent survey of the surface of the solids in Pond 18 performed in April 2011 and the original pond bottom probing performed in 2001, it is estimated that Pond 18 currently contains approximately 13,000 cubic yards of solids (see additional discussion in Section 1.4 below).

Sampling of the full section of material in Pond 15 during the 2001 investigation revealed that the total volume of material in the pond was approximately 19,000 cy, of which approximately 40-45 percent (or about 8,000 cy) was calcine tailings underlying the precipitation solids. There was also an indication of a minor amount of calcine tailings at the bottom of Pond 18, but not enough to merit separate accounting.

[1] Unpublished file information prepared by SEH, Inc.

The exposed surface of the material in the periodically unsubmerged portion of off-line Pond 13 appears to be comprised of precipitation solids. The nature of the materials at depth in Pond 13 is unknown. Review of boring and test pit logs in the dikes surrounding the pond indicates that the earthfill is locally mixed with some calcine tailings. This suggests the possibility that some portion of the materials below the solids exposed at the surface in Pond 13 may be calcine tailings, as was found in prior sampling in Pond 15. Given the very soft condition of the exposed near-surface materials and the very shallow water depth on the submerged portion of the pond during the 2001 surveys, Pond 13 could not be safely accessed for depth measurement or sampling. In the absence of survey/probe data, the order of magnitude volume of material in Pond 13 has been estimated as 20,000 cy based on topographic spot elevations in the unsubmerged portion of the pond from a pre-1995 topographic map of the Site and an estimate of the elevation of the pond bottom extrapolated from data in the adjacent probed ponds.

Relatively few settled solids were observed below Pond 11 and those ponds are not included in the removal, drying and repository storage plans for the Site.

Based on prior site geologic and geotechnical investigations (see geologic map and sections in Appendix A and boring and test pit logs in Appendix B), it is inferred that the bottom of Pond 18 was excavated into underlying predominantly coarse-grained (sand, gravel and cobble) alluvial aquifer deposits. Measurements of water levels in monitoring wells adjacent to Pond 18, as supported by readings in temporary piezometers installed in 2001-2002, indicate that the depth to groundwater within the pond solids has varied from the top surface to near the bottom of the pond solids retlecting a range of seasonal and climatic (drought versus wet period) conditions. Recent measurements over the past 10 months of the nearest monitoring wells indicate that groundwater levels were highest in July and lowest in December-March. The highest groundwater levels project to about two (2) to three (3) feet above the average bottom elevation of solids in Pond 18, and the lowest levels project to the approximate average bottom elevation of solids in Pond 18.

1.4 Pond 18 Solids Characteristics

Paser (1996)[2] recovered piston-style core samples of the solids from Pond 18, which at that time were approximately 8 feet thick. Subsequent detailed grid probing in 2001 indicated an average sediment thickness of 10.5 feet.

Based on previous testing in 2002[3] of minimally disturbed core samples from Ponds 11, 12, 14, 15 and 18 acquired in 2001, the settled precipitafion solids (prior to any in-pond consolidation by dewatering during low groundwater periods) are estimated to have a weighted average solids content (weight of dry solids/total wet weight) of 12.9 percent and an average particle specific gravity of 2.42. Following a planned dewatering exercise from September 2001 to June 2002, which included a winter groundwater level at or below the base of Pond 18, the average bulk unit weight of the solids was estimated at 23 pcf Based on a recent survey of the top of solids in Pond 18 made in April 2011 and the 2001 pond bottom contours, it is estimated that there are approximately 13,000 cubic yards of solids in

[2] Paser, Kathleen S. 1996. Characterization of and Treatment Recommendations for the St. Louis Adit Drainage and Associated Settling Ponds in Rico, Colorado: MS Thesis, Colorado School of Mines. August 30.

[3] Unpublished file information prepared by SEH, Inc.

Pond 18, and that the average thickness of the solids is on the order of four (4) to five (5) feet.

Permeability testing of the solids has not been performed due to the significant physical access challenges and safety concerns of working on water over the solids or accessing equipment direcfly on the very soft solids surface where unsubmerged. Esfimates of vertical permeability of the in situ solids in Pond 18 as of 2002 based on column testing of solids sampled from the pond were on the order of 8×10^{-5} cm/sec for the modeled pre-dewatering case and 3×10^{-5} cm/sec for the in-pond consolidation model[1]. These estimated vertical permeabilities of undisturbed solids appear generally consistent with the bulk unit weight and fine-grained nature of the solids. Given the approximately seven (7) additional months that water has recently been routed around Pond 18, it is possible that some additional consolidation and settlement has occurred, and that the current vertical permeability may be somewhat lower.

These laboratory-scale estimates have also been compared to an estimate made by proportioning the total previously estimated seepage from all active ponds from Pond 18 through Pond 5 (estimated by a mass balance calculation of surface flows and evaporation as approximately 250 gpm or 0.56 cfs) to each pond based on its bottom area. On this basis, the back-calculated overall average vertical permeability (K_v) for the Pond 18 solids would be on the order of 1×10^{-5} cm/sec. Given that this mass-balance derived estimate includes the lower Ponds 9 through 5 with little to no visible solids, it is not unreasonable to estimate that the actual average vertical permeability of the Pond 18 solids on this basis would be somewhat lower.

2.0 Solids Removal

Two primary altematives will be evaluated and tested in the field to arrive at one or more acceptable procedures to remove and transport solids from Pond 18 to the interim drying facility. The information gathered during the Pond 18 removal in the summer of 2011 will serve as the initial basis for selection of the removal method(s) for the other upper ponds during 2012-2013, with any appropriate modifications in the chosen method to reflect specific conditions that are encountered during the actual removal.

The first altemative is use of conventional earthmoving equipment, which is believed most suitable for solids to be excavated above the groundwater table at the time of removal based on pilot scale investigations conducted in 2001-2002. This altemative will involve the following steps:

1) Route incoming flow around Pond 18 to the next downgradient pond in the flow path (Pond 15) (this step was completed in fall 2010).
2) Decant and pump off remaining surface water from Pond 18 to allow additional solids consolidation in-place for as long as the overall construction schedule would allow (completed in fall 2010); pump snowmelt and precipitation accumulated since fall 2010 to Pond 15 prior to commencing removal in 2011.
3) Excavate solids with conventional earthmoving equipment, likely including a low ground pressure tracked excavator with extended boom reach and possibly a

rubber tire or tracked loader; swamp pads and/or earthen causeways may be required to access and facilitate controlled removal of solids.

4) Haul solids by truck and/or loader to the interim drying facility.

5) Deposit and spread solids in drying cells at the interim drying facility, using a small dozer and possibly a small conventional loader and/or skid-steer loader.

It is proposed to leave approximately two (2) feet of solids relatively undisturbed in the bottom of Pond 18 to limit seepage loss to the underlying predominantly coarse-grained alluvial aquifer. Based on the information from the 2001 investigation described previously and recent survey of the current top of the solids, it is estimated that approximately 5,000 cy of the 13,000 cy in Pond 18 will be left in place. Special care will be taken by means and methods to be determined in the field to minimize to the extent practical over-excavation of the solids to remain in place.

Secondly, a dredging altemative will be evaluated. This altemative would involve:

1) Perform a limited pilot test of removing un-dewatered solids from Pond 15 using a floating suction dredge.

2) Take measures to limit any additional solids being moved from Pond 15 to the lower ponds during the test including, but not necessarily limited to: a. the test will be performed on the upper portion of the pond to allow solids suspended in the water column opportunity to setfle out within the pond; b. the Pond 15 outlet will be blocked or re-routed (possibly to Pond 13) during the test; c. water quality samples will be taken at the ponds system discharge point to the river; and d. the test will be of a relatively short duration.

2) Dredge solids with a suction dredge with an appropriately designed, continuously agitating suction head to counteract the apparent thixotropic-like behaviour (i.e., tendency for solids to behave as a solid versus as a slurry in the absence of constant agitation) observed during the 2001-2002 pilot scale dewatering and removal exercise at Pond 18;

3) Convey solids via pipeline to a separate cell, sub-cell, or tank in the interim drying facility, which will not be mixed with solids removed from Pond 18 so as not to compromise the drying of Pond 18 solids.

4) If necessary, excess water removed to the interim drying area during the test can be decanted, or actively pumped, back to Pond 15 or Pond 13 once initial solids settling has occurred.

As necessary to develop and prove the feasibility of the dredging altemative, a dredging contractor may be engaged to perform field-scale trial removal from Pond 18, but only after more consolidated, dried solids have already been removed with conventional equipment. This will be dependent on the amount and water-content of remaining solids in Pond 18. This option will be considered after significant solids removal in Pond 18 has occurred, and the viability of removing additional solids with a dredge has been assessed in the field. As in the case of the conventional excavation method, approximately two (2) feet of sediment will be left in the bottom of Pond 18. Again, special care will be exercised to develop a means to ensure that disturbance of the solids to remain is minimized to maintain their lining effect.

3.0 Interim Drying Facility

3.1 Siting

The available open ground in the former Ponds 16/17 area is plamed to be used for the interim drying of solids removed from Pond 18 as shown on Figure 2. This location is strongly preferred considering:

- Close proximity to Pond 18 and the other upper ponds containing the majority of the solids to be processed limits transport distances.
- Existing accessibility to both conventional equipment for cell constmction and solids placement and piping for dredge discharge;
- Surface grade is above the seasonal high groundwater level so that downward drainage of the placed wet solids will not be impeded by underlying groundwater;
- Sufficient gently sloping ground is present for placement of Pond 18 solids in a relatively thin layer to promote more efficient drainage and consolidation;
- Existing ground generally slopes in an advantageous direction to promote drainage of dewatering water along the base of the placed solids while minimizing the cut/fill; and
- Available grade is present for gravity conveyance of dewatered pore water from the consolidating solids to Pond 15 in the active ponds system.

Use of this interim facility for drying of solids removed from Ponds 11 through 15 during 2012-2013 will be considered depending on the performance observed during 2011 and on later decisions regarding the layout and design of the ponds treatment system and solids repository. The potential to convert an interim drying facility at this location to a pemianent facility is also considered feasible based on information and evaluations to date.

Altemative locations for the interim drying facility were considered, but determined less feasible than the Ponds 16/17 area. These locations include the relatively open flat area north of Pond 18 and the currently off-line Pond 13. Disadvantages of the north area site as compared to the Ponds 16/17 site include: 1) having to transport removed solids considerably fiirther and upslope by about 6-18 feet of elevation more; 2) the need to completely encircle the site with a containment dike; and 3) significantly more grading of the subgrade to promote gravity drainage of non-infiltrating dewatering water to a down-gradient sump. The Pond 13 altemative site is seasonally submerged by an estimated one (1) to two (2) feet of water and was therefore not considered fiirther. If necessary based on later decisions regarding the layout and design of the ponds treatment system primary settling pond and the solids repository, one or both of these sites could be fiirther considered during siting and design of the permanent drying facility.

3.2 Site Geologic and Groundwater Conceptual Model

The conceptual geologic model of the preferred site for the interim drying facility is illustrated in plan and sections on figures in Appendix A. The immediate site consists nearly entirely of calcine tailings overlying alluvium of the Dolores River valley. A thin veneer (ranging from less than a foot to up to about two feet) of mixed fill, mine waste and debris is locally present at the surface of portions of the Ponds 16/17 area. The eastern side of the site locally overlies the toe of the waste rock pile placed during construction of and subsequent mining in the St. Louis Tunnel and cross-cuts. The westem limit of the site area abuts embankment fill over alluvium retaining Ponds 18 and 15 to the west; the southern site boundary lies along the embankment separating Ponds 16/17 from Pond 13 (that in tum overlies alluvium); and the site is bounded on the north by mixed fill, mine waste and debris overlying alluvium.

Groundwater is present in the alluvium beneath the site areas at depths on the order of five (5) to 10 feet based on the groundwater level data shown on the sections in Appendix A. Note that although the available groundwater data spans a very substantial period of time (nearly 30 years), the groundwater levels inferred from the data appear remarkably consistent and reasonable. Based on the available data, the gradient of flow in the groundwater has a component from north to south (as would be expected following the downstream slope of the shallow alluvial aquifer along the Dolores River), and also a component from east to west (consistent with groundwater discharging from CHC Hill/Telescope Mountain) toward the Dolores River). The deeper calcine tailings in the southern portion of the proposed interim drying facility footprint lie on the order of five (5) to seven (7) feet below the estimated average groundwater table.

3.3 Calcine Tailings

The preferred location for the interim drying facility in the area of the now dry Ponds 16/17 overlies *calcine tailings* placed during past ore processing activities on site. The process leading to the formation of the calcine tailings and what is currently known about their physical and chemical characteristics is summarized in the following paragraphs.

Formation of Calcine Tailings. Calcine tailings are formed as a byproduct of roasting of pyrite ores. *Roasting* is "the process of heating metallic sulfide ores in air to convert sulfides to oxides", typically used to create sulfuric acid. Technically, *calcination* is different from *roasting* because calcination denotes thermal decomposition as in heating limestone to drive off carbon dioxide. Nonetheless, the solid product of both types of operations is referred to as a *calcine.* The so-called *calcine tailings* south of the St. Louis Tunnel portal at Rico are not truly tailings as would have been produced by a concentrating operation, but are simply calcine.

A plant for producing sulfuric acid from pyrite (Fe_2S) mined locally was constmcted in September 1955 and the "...acid plant ran for 9 years, until a cutback in the uranium program destroyed the market for the acid."[4] According to McKnight (1974), pyritic tailings from the lead-zinc mill were concentrated to provide feed for the first 15 months, but exhaustion of this source led to mining of massive pyrite, mostly from the mines of CHC Hill.

By the 1950s, most pyrite roasting plants used the Dorr-Oliver *Fluosolid*© apparatus that used a draft fan to suspend fine particles of pyrite in an upward-flowing stream of air. Oxygen in the air reacted with pyrite at about 600 °C as follows: $2FeS_2 + 5½O_2 = Fe_2O_3 +$

[4] *"Geology and Ore Deposits of the Rico District, Colorado", E. T. McKnight, USGS Professional Paper 723, 1974.*

$4SO_2$. The offgas from the roaster were drawn through a settling chamber, thence through dust cyclones and a wet scmbber; the mixture of wet sludge and dry particulates that were captured was ***calcine***. The cleaned gases, containing about 10% SO_2, were treated in a processing unit called a contact/absorption acid plant where sulfiır dioxide, SO_2, was catalytically converted to sulfur trioxide, SO_3, which was absorbed in water to create sulfiıric acid, H_2SO_4. Typically, acid plants of this type produced a commercial grade of acid that contained about 93% H_2SO_4 and 7% H_2O.

Pyrite oxidizes in a roaster at a temperature too low for appreciable oxidation of the sulfides of other base metals to occur, so the calcine will typically contain chalcopyrite, galena, and sphalerite (if those minerals were present in the ore), in addition to synthetic hematite, Fe_2O_3. This is generally consistent with the analyses of mineral phases present in the Rico calcine tailings as discussed immediately below.

Physical and Chemical Characteristics of Calcine Tailings. Calcine tailings have been encountered in nine (9) test pits and seven (7) borings in the Ponds 16/17 area to date. A map and sections showing their locations are included in Appendix A and logs of these test pits and borings are presented in Appendix B. No geotechnical testing of the calcine tailings has been performed to date, but based on on-site observations and the descriptions in the logs in Appendix B they are generally described as: silty fine to very fine sand (SM); purple, maroon or red to dark red; loose to medium dense; and varying from dry to saturated depending on their location relative to the groundwater table at the site. The hydraulic conductivity of the calcine tailings has not been measured to date in the field or laboratory, but is estimated to be on the order of as high as 10^{-4} to as low as 10^{-6} cm/sec based on the above grain size description.

Selected samples of calcine tailings from borings EB-1 and EB-2 were submitted to Dr. John Drexler at the University of Colorado at Boulder for qualitative microprobe review. The samples were selected at varying depths from near surface (5-7 feet) above the water table from the middle of the deposit (10-12 feet), to the bottom of the deposit (22-24 feet) below the water table. The results of Dr. Drexler's review are presented in Appendix C. These results are summarized as follows:

1) Iron oxide was a predominant phase in most samples, consistent with the genesis of the calcine tailings as discussed above; pyrite was only observed in the deepest sample (22-24 feet).

2) Calcite is abundant in the deeper samples (below 10-12 feet).

3) Other minerals present to abundant include quartz, microcline (feldspar), sphalerite and galena; minor zinc and copper sulphate were observed in the two deepest samples (20-24 feet).

4) Gypsum is variably present in the samples; it is abundant in the two deepest samples (20-24 feet), present in minor quantities in the two shallowest samples 5-9 feet), and absent in the one mid-depth sample 10-12 feet).

The observed near neutral pH of the groundwater in the vicinity of Ponds 16/17 (see data in Appendix D) is consistent with the observation of abundant calcite in the deeper calcine tailings samples and with previous acid neutralization testing that was performed (but for which the results have not yet been found in archival project files).

Evaluation of Potential Effects on Groundwater. Given the proposed siting of the interim solids drying facility over the calcine tailings, geochemical sampling and evaluation is proposed to assess the potential for additional release of metals due to infiltration of dewatered pore fluids from the deposited solids in the drying beds into the underlying calcine tailings, as follows:

1) Collect Shelby tube samples of calcine tailings from at least three (3) depth horizons at the approximate third points through the deposit; two of the samples would likely be above the water table with the third sample intentionally collected below the water table.

2) Collect pore fluid from treatment solids removed from Pond 18 and freshly deposited in the interim drying facility either by field extraction with a porous cup lysimeter and vacuum or by lab extraction of fluid from a bulk solids sample using a Buchner funnel.

3) Perform two suites of synthetic precipitation leaching procedures (SPLP) testing on the calcine tailings samples using two types of extracting fluids: a) pore fluid collected from the existing solids in Pond 18 to represent the anticipated leaching fluids from the interim drying facility; and b) Westem US SPLP leachate solution to simulate leaching through calcine tailings with infiltrating snowmelt/rainwater (the existing condition prior to constructing the interim drying facility).

4) If the results of previous acid-base accounting tests on the calcine tailings are not retrievable from archival records, these tests will also be performed on the samples collected under item 1) above.

5) Additionally, samples of the calcine tailings will be collected for pH analysis.

Given the known very low driving hydraulic head of the dewatered pore fluid in the interim drying cells and the estimated low to very low permeability of the underlying calcine tailings, it is anticipated that very litfle infiltration and permeation of the calcine tailings by the dewatered pore fluid will occur. However, testing is proposed to evaluate the potential for additional metals release in the event that some flux of solids dewatering pore fluid does occur through the calcine tailings. The proposed leaching procedures will be used to evaluate the change in pore fluids when the leaching fluid changes from the existing conditions to an alkaline dewatering fluid derived from the interim drying beds. Comparison of leaching with the two different fluids will indicate whether given constituents will increase, decrease, or remain the same if the leaching solution changes. The results of both leachate procedures can then also be compared with historic and ongoing monitoring of groundwater quality beneath and in the vicinity of the interim drying facility in existing and proposed new monitoring wells. The results of this proposed program of geochemical sampling and analysis will provide guidance for continued operation of the interim drying facility and for final design and operation of a permanent solids drying facility.

3.4 Interim Drying Facility Layout

As shown on Figure 3, the combined Ponds 16/17 area will be subdivided into several cells (four shown). Each cell will have a different design and operation that will allow for evaluation of drying technologies for a permanent facility. The cells will be set back and isolated from Ponds 18, 15 and 13 with an earthen containment dike/access road. This access would be used for solids hauling/placing, and also for future repairs/upgrades if/as needed to the existing adjacent upper pond embankments. Compacted earth dikes will be used to enclose and divide the cells, which will be sized for height to accommodate the solids removed from Pond 18 (and possibly later from the other upper ponds as necessary pending constmction of a permanent drying facility), with sufficient freeboard to accommodate direct precipitation (rainfall and snowmelt). Stormwater run-on will be intercepted in a ditch/berm around the upslope limits of the drying facility and conveyed to the ponds system.

The Ponds 16/17 area generally consists of approximately one (1) foot of random rock fill over 15 to 25 feet of calcine tailings from historical pyrite ore processing activities. The rock fill and any other materials or debris present in the footprint of the drying facility will be removed. The area of each cell will be graded to drain generally from northeast to southwest, to a sump that will be used to collect gravity-induced drainage from the placed solids that does not directly infiltrate the underlying calcine tailings (if any) and direct precipitation, which will in turn be conveyed by gravity or pumping to Pond 15 (see Figures 3 and 4).

3.5 Drying Cell Conceptual Design and Operation

It is expected that there will be four (4) cells in the interim drying facility, divided by earthen berms, with access by vehicles provided to each cell. The design of each cell varies to provide for evaluation of different drying cell procedures for the permanent drying facility design. The actual number, configuration and purpose of each of the proposed individual drying cells may change during the course of the Pond 18 solids removal based on the characteristics of the solids at the time they are removed. Adjustments to the initial layout, configuration and operation of the cells will be made, if/as necessary in response to ongoing evaluation of the removal and drying facility operations and performance. The initial four (4)-cell concept is provided on Figure 3 and its constmction and operation is further described as follows:

- Drying Cell 1 would consist of a perimeter dike with bottom surface graded in the existing calcine tailings. Solids would be placed directly on the calcine tailings with no underlying placed filter or drainage media. Once placed the solids would be left undisturbed until the maximum practical dewatering and consolidation by evaporation and downward drainage had occurred.
- Drying Cell 2 would be constmcted and operated consistent with Cell 1, except that the solids would be periodically tilled to promote evaporative drying.
- Drying Cell 3 would include a perimeter dike with graded bottom surface on calcine tailings that is subsequently covered with a layer of gravel to provide a high efficiency drainage media to promote downward gravity drainage of pore water from the overlying solids into and then laterally through this highly permeable drainage layer. This concept would also test the tendency for the solids to "pipe" (intemally

erode) into the open voids in the gravel blanket. The gravel layer would be connected to the sump at the low point of the cell.

- Drying Cell 4 would be designed and operated as for Cell 3 except that a graded soil filter would be placed between the overlying solids and the underlying gravel blanket. If the filter layer acts to prevent piping of the solids into the gravel drain, but clogs in the process, then means and methods to efficiently remove and replace the filter during operation of the facility would be evaluated.

The height of the perimeter dikes will be set to minimize to the extent practical both the depth of sohds to promote more rapid and efficient drying and the plan area necessary to devote to solids drying. The footprint area and slopes of the new perimeter dikes will be set based on bearing capacity and settlement considerations of the calcine tailings foundation material, as well as stability requirements based on the nature of the embankment borrow sources (whether on- or off-site) relative to stormwater, precipitation, and seepage considerations. The drainage media (gravel layer and soil filter, where placed) will be designed based on hydraulic requirements to carry the required flows, and filter criteria to mitigate piping while maintaining adequate permeability. Details of the design and construction of the interim drying cells may vary depending on whether the solids are conveyed and placed by conventional earthmoving equipment or by suction dredge and pipeline.

4.0 Evaluation of Removal Methods and Drying Cell Performance

The means and methods utilized to remove and transport solids from Pond 18 to the interim drying facility will be thoroughly documented with field notes and digital photographs and video. The volume of solids removed and the depth of solids left in place will be tracked by survey/direct measurements (if safe access can be made) and/or load counts (if removed and transported by conventional earthmoving equipment) or pipe discharge measurement (if removed by dredge and conveyed by pipe).

The purpose of the multi-cell approach to the interim drying facility is to evaluate, on a field scale, the most efficient method(s) for dewatering and consolidation of the precipitated solids, which can then be applied, as appropriate, to future solids removal from the other upper ponds and long-term management of solids generated during operation of the overall treatment system. It is anticipated that the solids drying performance of the interim drying facility will be evaluated for key parameters using a combination of the following techniques:

- *Solids Drying Time*: Periodic measurement of the approximate depth of sediment in the drying cells, indicative of the amount and time required for consolidation. Drying will be observed throughout the initial few months after solids are placed in the drying cells, as well as possibly in 2012 for up to a year after placement.
- *Solids Physical Characteristics over Time*: Recovery of Shelby tube samples of the sediment from each cell, for laboratory evaluation of moisture content, density, shear strength, hydraulic conductivity and consolidation changes over time. These parameters will be key input data for design of the permanent drying facility and solids repository.

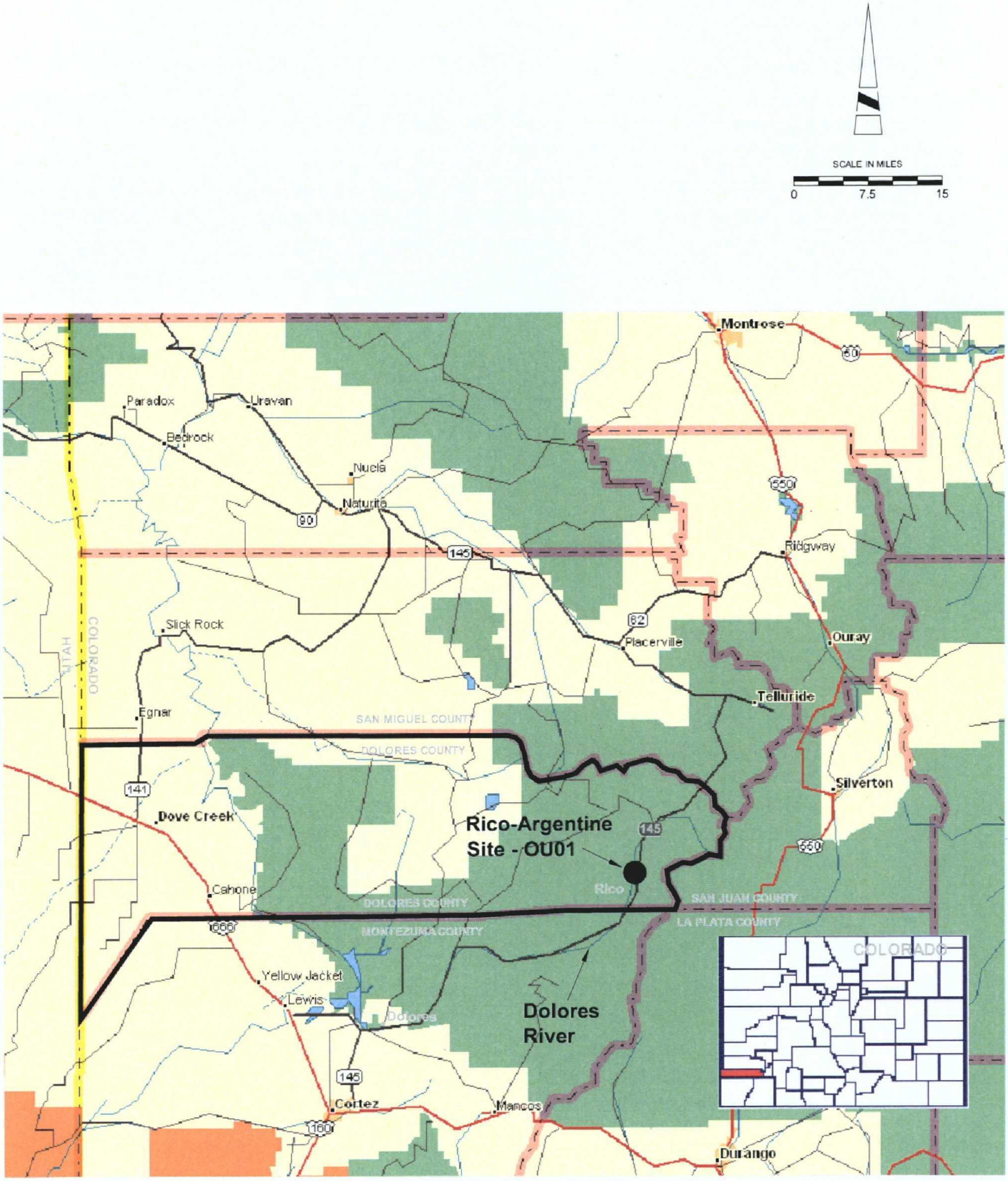
- *Drying Performance of Different Cells*: Excavation of test pits and observations of the gravel drain and earthen filter layers, where used, to assess potential for piping and clogging of these materials, and the resultant reduction in drainage efficiency and shear strength of the overlying solids.
- *Drainage Water Characterization*: Evaluation of the approximate volume and chemical characteristics of surface drainage discharged from the drying cells to Pond 15, and of potential positive or negative effects of drainage water on metals release from the underlying calcine tailings. This information will assist in understanding how to manage the dewatering water, and assist design of the future water treatment facilities.
- *Dust Potential and Control Options*: An ongoing assessment will also be made of the potential for dust being generated during the solids drying, and the need for control of dust from the solids. The surface of the solids in the drying cells will be treated either with a light water spray, a suitable dust suppressant, or mixed/turned over with the underlying wetter solids, if/as necessary.

5.0 Schedule and Oversight

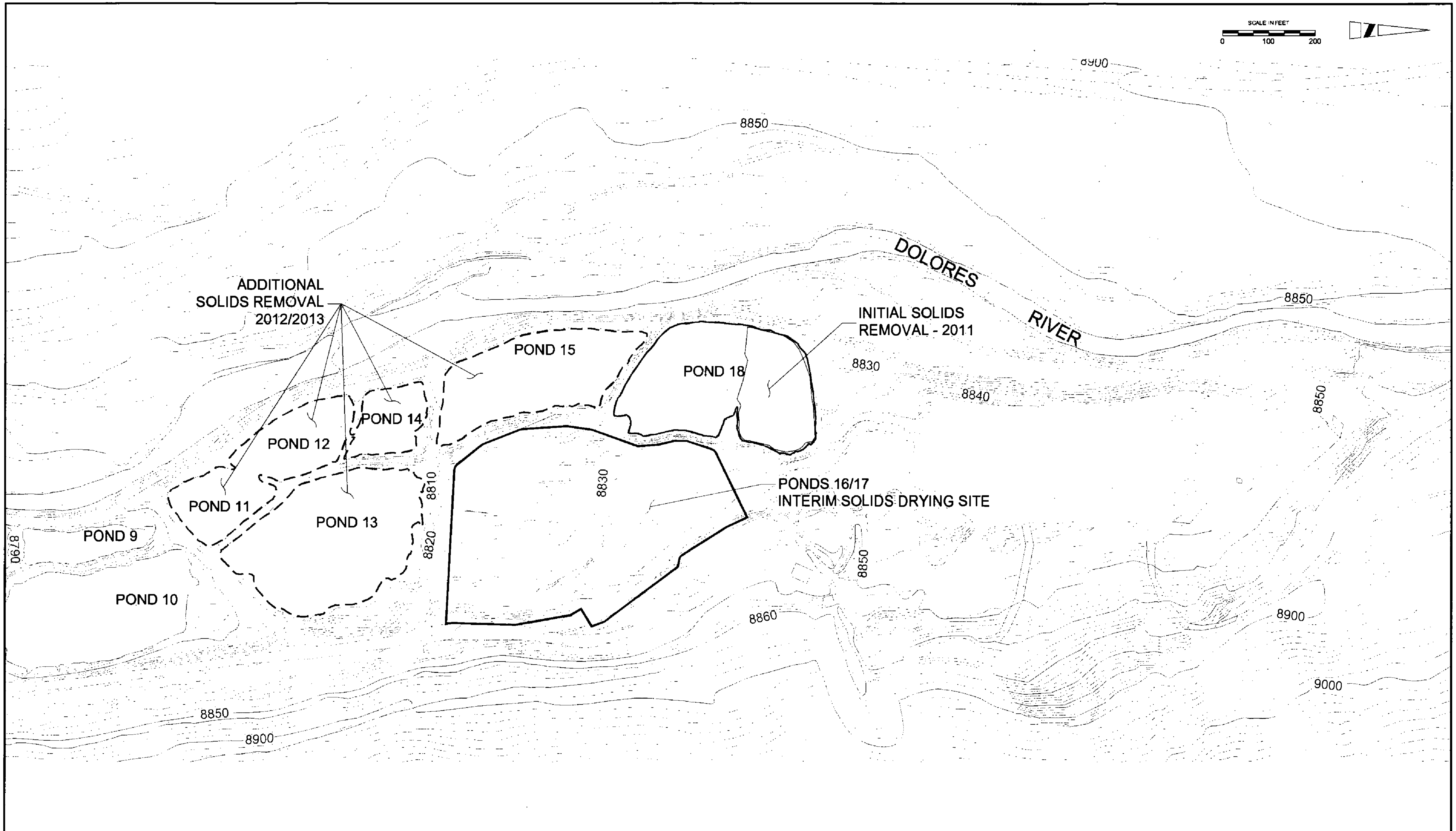
A request was made to revise the date of mobilization to the site to begin work to implement the Initial Solids Removal Plan from June 6 to the week of July 8, 2011 to allow for additional in-pond consolidation and settlement. Removal of sediment from Pond 18 will commence in mid to late summer 2011, following approval and construction of the interim drying facility. Removal of Pond 18 solids to the interim drying facility will likely be completed by late summer, but no later than December 1, 2011. The Removal Action Work Plan schedule contemplates the solids removed from Pond 18 will be placed in a new on-site solids repository by no later than December 2013. Removal of solids from the remaining upper ponds will be performed between July 2012 and December 2013. It is anticipated that these removals will be performed as early as practical during this period to allow for the greatest degree of dewatering and consolidation of the solids as feasible. Following adequate drying, EPA's schedule projects placement of existing solids into the solids repository between July 2013 and December 2014.

The activities of selected construction contractor(s) will be overseen by Atlantic Richfield representatives on a full-time, on-site basis. Depending on actual conditions encountered, appropriate adjustments in the sequence and/or the means and methods of removal may be identified. Any such adjustments will be presented to EPA for timely review and approval, and upon approval, implemented by the construction contractor.

In addition to observing the quality of the work, Atlantic Richfield field oversight and design team members will also implement the activities described previously to evaluate performance of the initial removal and interim drying operations.

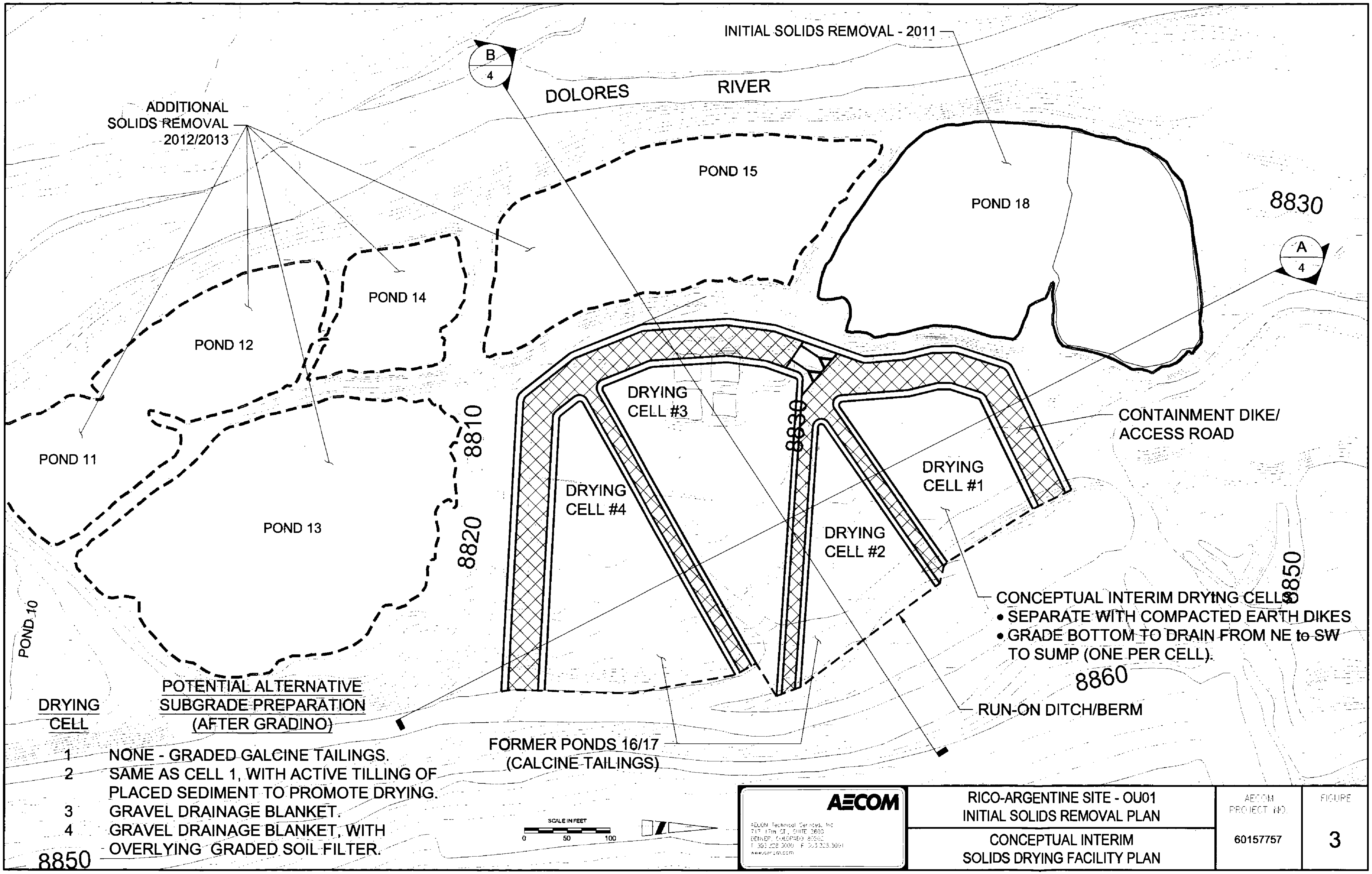


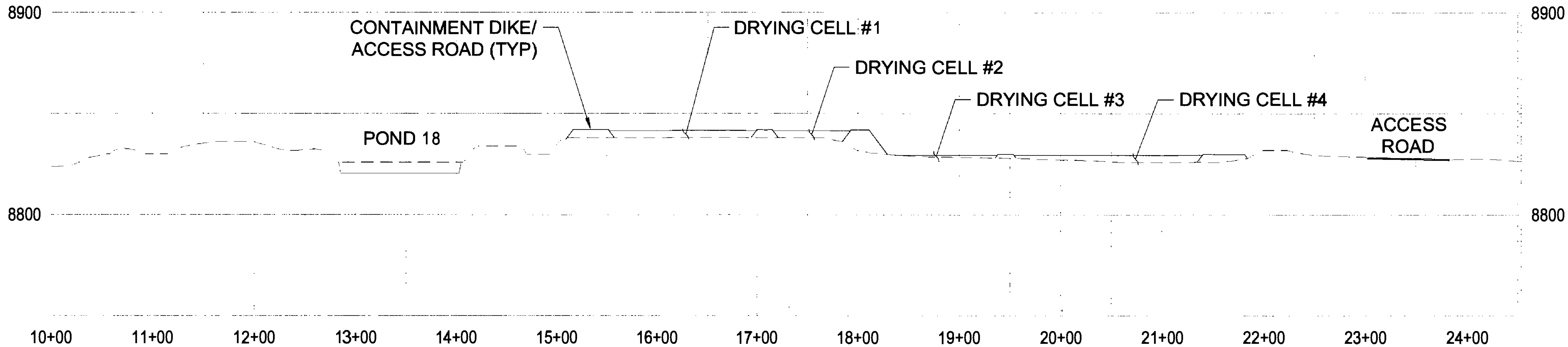
AECOM AECOM Technical Services, Inc. 717 17th ST., SUITE 2600 DENVER, COLORADO 80202 T 303.228.3000 F 303.228.3001 www.aecom.com	RICO-ARGENTINE SITE - OU01 INITIAL SOLIDS REMOVAL PLAN	AECOM PROJECT NO.	FIGURE
	LOCATION MAP	60157757	1



AECOM

RICO-ARGENTINE SITE - OU01 INITIAL SOLIDS REMOVAL PLAN	AECOM PROJECT NO	FIGURE
INITIAL SOLIDS REMOVAL AND INTERIM SOLIDS DRYING SITE	60157757	2

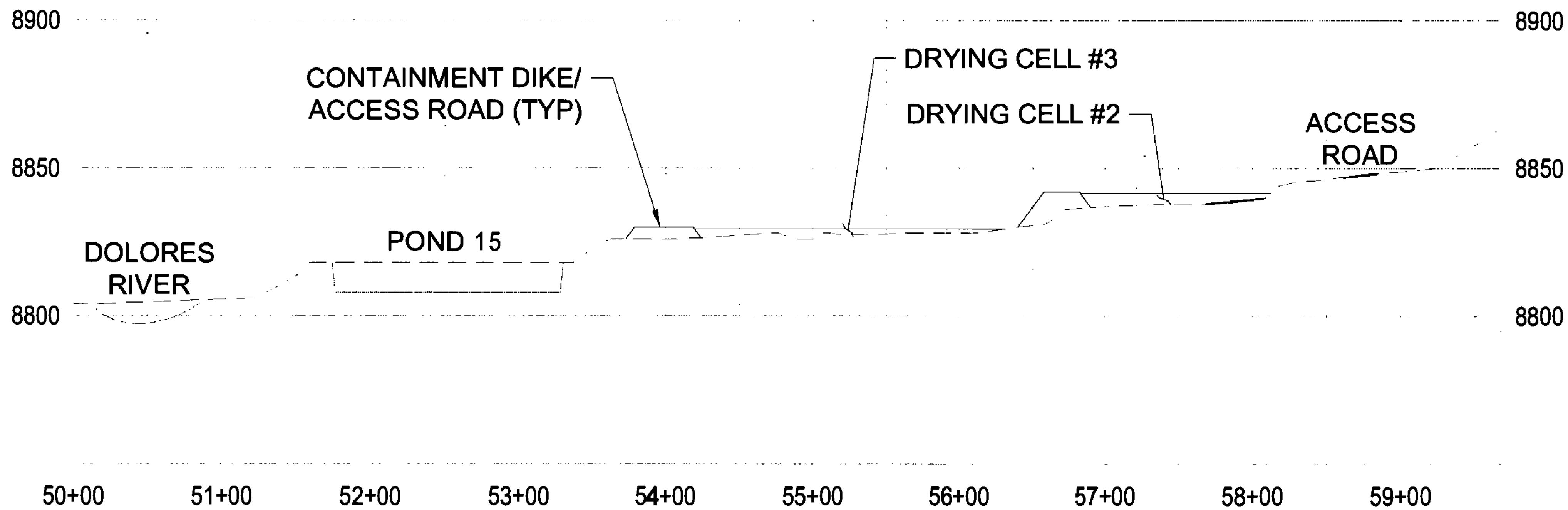

INITIAL SOLIDS REMOVAL - 2011
B
4
DOLORES
RIVER
ADDITIONAL
SOLIDS REMOVAL
2012/2013
POND 15
POND 18
8830
A
4
POND 14
POND 12
POND 11
POND 13
8810
8820
DRYING
CELL #3
8830
CONTAINMENT DIKE/
ACCESS ROAD
DRYING
CELL #4
DRYING
CELL #1
DRYING
CELL #2
8850
POND 10
CONCEPTUAL INTERIM DRYING CELLS
• SEPARATE WITH COMPACTED EARTH DIKES
• GRADE BOTTOM TO DRAIN FROM NE to SW
TO SUMP (ONE PER CELL).
8860
RUN-ON DITCH/BERM
FORMER PONDS 16/17
(CALCINE TAILINGS)
DRYING
CELL
POTENTIAL ALTERNATIVE
SUBGRADE PREPARATION
(AFTER GRADING)
1 NONE - GRADED CALCINE TAILINGS.
2 SAME AS CELL 1, WITH ACTIVE TILLING OF PLACED SEDIMENT TO PROMOTE DRYING.
3 GRAVEL DRAINAGE BLANKET.
4 GRAVEL DRAINAGE BLANKET, WITH OVERLYING GRADED SOIL FILTER.
8850
SCALE IN FEET
0
50
100
AECOM
RICO-ARGENTINE SITE - OU01
INITIAL SOLIDS REMOVAL PLAN
CONCEPTUAL INTERIM
SOLIDS DRYING FACILITY PLAN
AECOM
PROJECT NO.
60157757
FIGURE
3



SECTION THRU CONCEPTUAL INTERIM DRYING CELLS (A)

SCALE: HORIZ. 1" = 100', VERT. 1" = 50'

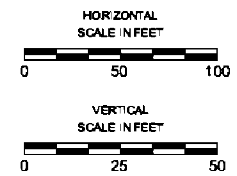
Vertical Scale Exaggeration - 2H:1V



SECTION THRU CONCEPTUAL INTERIM DRYING CELLS (B)

SCALE: HORIZ. 1" = 100', VERT. 1" = 50'

Vertical Scale Exaggeration - 2H:1V



AECOM	RICO-ARGENTINE SITE - OU01 INITIAL SOLiDS REMOVAL PLAN	AECOM PROJECT NO.	FIGURE
	CONCEPTUAL INTERIM SOLIDS DRYING FACILITY SECTIONS	60157757	4

APPENDIX A

SITE GEOLOGY AND GROUNDWATER CONCEPTUAL MODEL

Rico St. Louis Ponds
Groundwater Level Measurements

Date	Groundwater Well Piezometer Levels				
	GW-4	GW-5	GW-6	GW-7	EB-2
19-Mar-11	Under Snow	21.86	Under Snow	Under Snow	16.74
15-Apr-11	9.6	19.73	19.72	20.81	15.61
19-Apr-11	9.48	19.5	21.15	20.66	15.37
26-Apr-11	9.38	19.19	20.9	20.36	15.15
3-May-11	9.42	18.95	19.12	19.91	15.1
12-May-11	14.21	18.94	19.05	19.75	19.75
18-May-11	9.33	18.7	20.39	19.61	14.84

WELLS / BORINGS

⊗ DH-1 (ANDERSON ENGINEERING/SEH, 2008)

EW-1, EB-1 (SEH, 2004)

GW1 (CDPHE, 2003)

B-1 (DAMES AND MOORE, 1981)

EH-1 (ANACONDA MINERALS)

DOMESTIC WELL

TEST PITS

TP-1 (ANDERSON ENGINEERING/SEH, 2008)

TP-2004A (SEH, 2004)

TP-A (SEH, 2001)

APB-1 (ANDERSON ENGINEERING, 1996)

GEOLOGIC UNITS

e	EMBANKMENT FILL, RIPRAP
f	ROAD FILL, PAVEMENT
wr	WASTE ROCK
ct	CALCINE TAILINGS
so	SPENT ORE
f/mw/d	MISCELLANEOUS FILL, MINE WASTE (TAILINGS, WASTE ROCK, ORE), BURIED DEMOLITION DEBRIS
Q_{al}	ALLUVIUM
Q_f	FAN DEPOSITS
Q_{tw}	TALUS, SLOPEWASH (COLLUVIUM)
Q_l	LANDSLIDE DEBRIS
TK_{lp}	LATITE PORPHYRY INTRUSIVES
P_{cu}	CUTLER FORMATION - SILTSTONE, ARKOSE AND CONGLOMERATE
P_{hl}	HERMOSA FORMATION (LOWER MEMBER) - SANDSTONE, SILTSTONE, SHALE, MINOR LIMESTONE OR DOLOMITE
P_l	QUARTZITE
M_l	LEADVILLE LIMESTONE
md	METADIORITE
g	GREENSTONE

SYMBOLS

GEOLOGIC CONTACT

D U BEDROCK FAULT; D * DOWN-THROWN SIDE, U * UP-THROWN SIDE

12 STRIKE AND DIP OF BEDDING

65 TREND AND PLUNGE OF FOLIATION

W.L. MEASURED 6/11/11

6/2/09 W.L. MEASURED ON DATE SHOWN

W.L. DURING DRILLING/EXCAVATION

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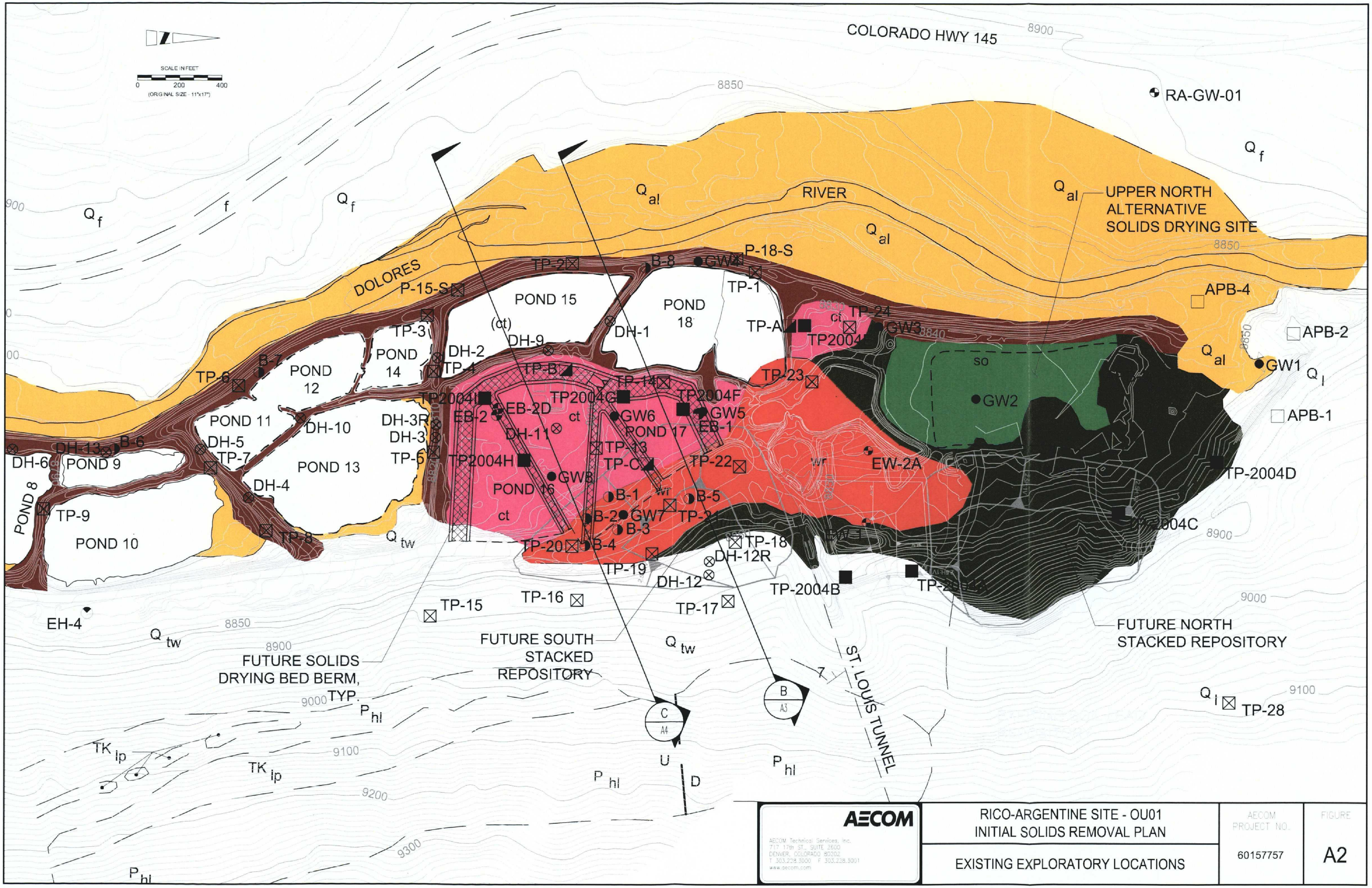
	GEOLOGIC LEGEND	60157757	A1



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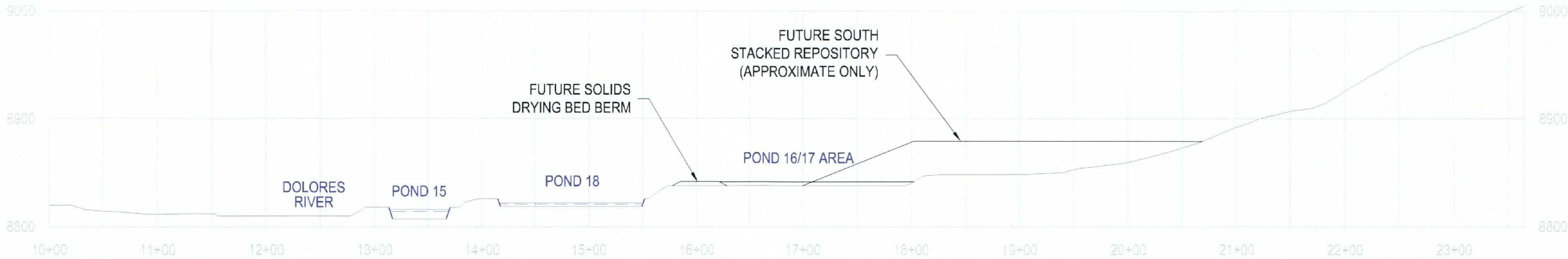
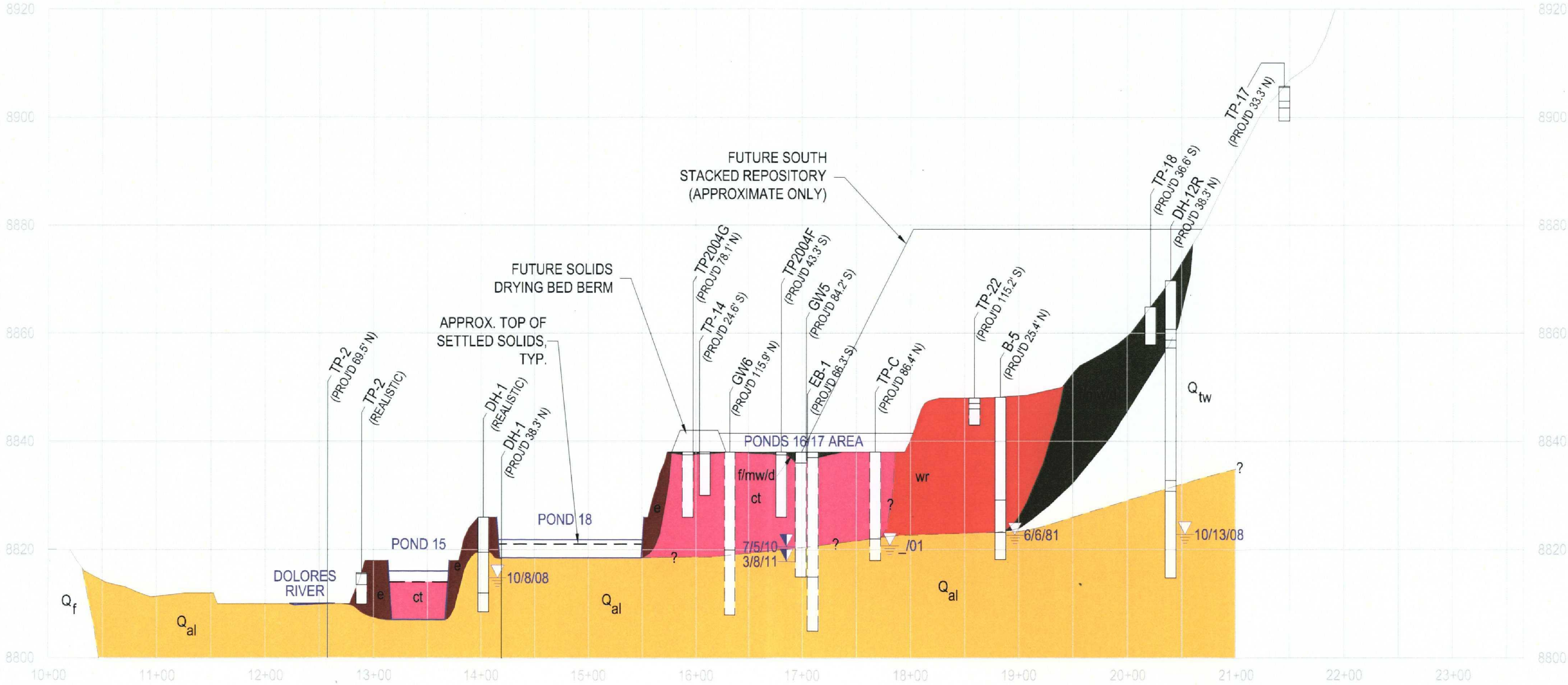
RICO-ARGENTINE SITE - OU01
INITIAL SOLIDS REMOVAL PLAN

EXISTING EXPLORATORY LOCATIONS

AECOM PROJECT NO.	FIGURE
60157757	A2



B
–
SECTION
SCALE: H&V: 1'=100'



B
–
SECTION (EXAGGERATED)
SCALE: H: 1'=100', V: 1"=20'

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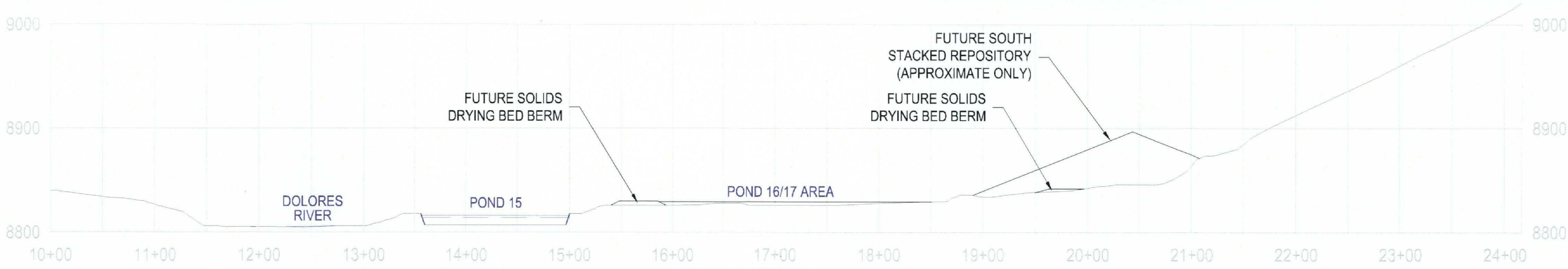
RICO-ARGENTINE SITE - OU01
INITIAL SOLIDS REMOVAL PLAN

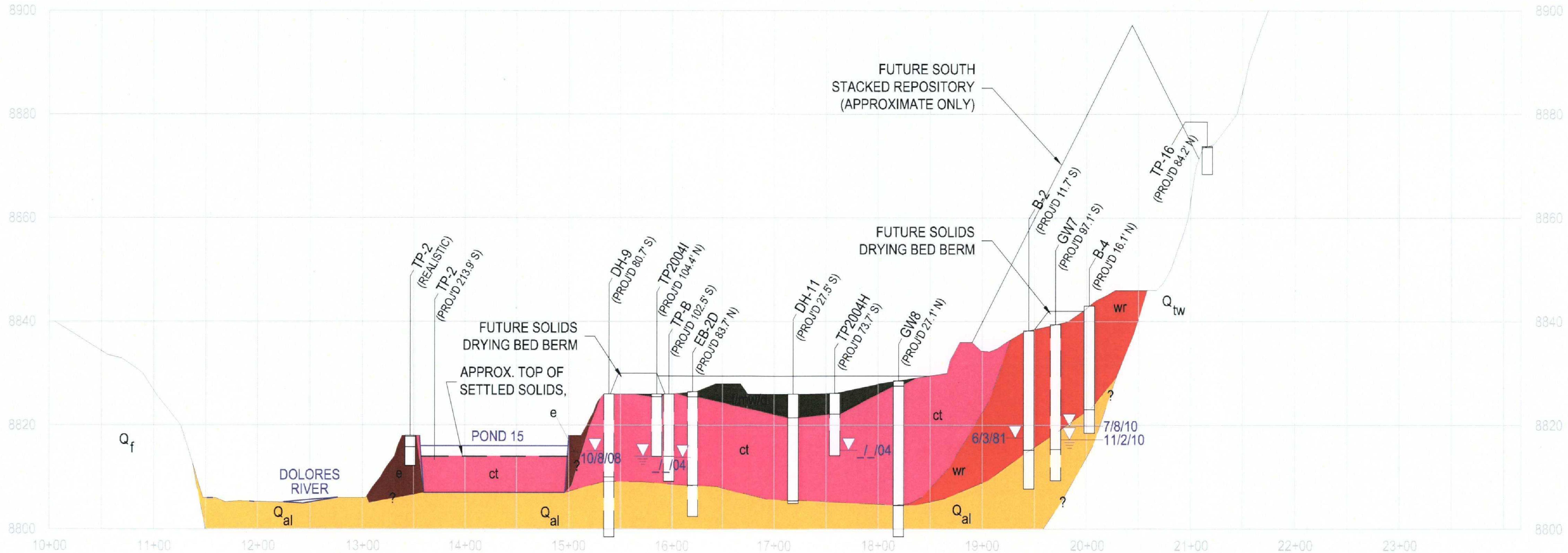
GEOLOGIC SECTION B-B

AECOM PROJECT NO.
60157757

FIGURE
A3



C
-
SECTION
SCALE: H&V: 1"=100'



C
-
SECTION (EXAGGERATED)
SCALE: H: 1"=100', V: 1"=20'

AECOM AECOM Technical Services, Inc. 717 17th ST., SUITE 2600 DENVER, COLORADO 80202 T 303.228.3000 F 303.228.3001 www.aecom.com	RICO-ARGENTINE SITE - OU01 INITIAL SOLIDS REMOVAL PLAN	AECOM PROJECT NO.	FIGURE
	GEOLOGIC SECTION C-C	60157757	A4

APPENDIX B
BORING AND TEST PIT LOGS/
GEOTECHNICAL DATA

Rico-Argentine Site: Pond 16 / 17 Area - Calcine Tailings Summary

Test Pit / Boring No.	Calcine Tailings Depth, ft	Comment
TP-2004F (SEH 2004)	0.5 - 12+	Tailings extend deeper than test pit
TP-2004G	0.5 - 12+	Tailings extend deeper than test pit
TP-2004H	4 - 12+	Tailings extend deeper than test pit
TP-2004I	0 - 12+	Tailings extend deeper than test pit
TP-B (SEH 2001)	0 - 12	Sand alluvium at 12 ft
TP-C	0 - 16	Sand / gravel alluvium at 16 ft
TP-13 (Anderson 2008)	3 - 8+	Tailings extend deeper than test pit
TP-14	0.5 - 8+	Tailings extend deeper than test pit
TP-22	0 - 2	Sand / cobble alluvium at 2 ft
GW-5 (CDPHE 2002)	2 - 23+	Tailings extend deeper than boring
GW-6	0 - 18	Cobble alluvium at 18 ft
GW-8	1 - 24	Cobble alluvium at 24 ft
EB-1 (SEH 2004)	1 - 23	Sand / gravel alluvium at 23 ft
EB-2	1 - 17	Sand / gravel alluvium at 17 ft
DH-9 (Anderson 2008)	0 - 16	Sand / gravel alluvium at 16 ft
DH-11	4.5 - 20.5	Sand / gravel alluvium at 20.5 ft

Geologic/Geotechnical Data

-Well/Boring Logs

-Test Pit Logs

-Geotechnical Data

Well/Boring Logs

- Anderson Engineering/SEH, 2008
- SEH, 2004
- CDPHE, 2003
- Dames and Moore, 1981

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-1	COORDINATES OR LOCATION: LAT: 37.7066 LON: -108.0317
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 11' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/8/08 DATE COMPLETED: 10/8/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -6.5	-5 to -7 (Shelby tube)		50%		CLAYEY SILT WITH SOME SAND AND GRAVEL; BROWN, MOIST
-6.5 to -17.5					SILTY SAND AND GRAVEL, DARK BROWN, MOIST
-11 to -12.5	-11 to -12.5 (SPT)	12 9 3	50%		WATER - SATURATED
-15 to -16.5	-15 to -16.5 (SPT)	13 33 27	50%		SATURATED COBBLES AND BOULDERS
-17 to -18.5	-17 to -18.5 (SPT)	50 / ½"	0		REFUSAL AT 17.5'

TD = 17.5'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-2	COORDINATES OR LOCATION: LAT: 37.7055 LON: -108.0313
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 14' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" · FLUID USED: N/A	DATE STARTED: 10/8/08 DATE COMPLETED: 10/8/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0					SANDY SILT, BROWN, MOIST
-3					CLAYEY SILT, MINOR SAND AND GRAVEL, RED, MOIST
-5	SPT	8 6 4	25%		SANDY SILT WITH GRAVEL, BROWN, MOIST
-8	SPT (-10)	24 4	0		CLAYEY SILT WITH SOME GRAVEL AND COBBLES, BROWN, MOIST
-11		3			RED WET SILTY SAND - CALCINE TAILINGS - NO RECOVERY-
-12	SPT	15 15 8	67%		BROWN CLAYEY SILT WITH GRAVEL AND COBBLES, MOIST, WOOD DEBRIS, WATER
-13.5	SHELBY TUBE		50%		DRILLING ON COBBLE, WOOD DEBRIS IN SPLIT SAMPLE
-15	SPT	15			
-15.5		14 50/3	50%		SAND AND GRAVEL, SATURATED, WITH COBBLE
-17	SPT (-17.5)	24 37	50%		SILT WITH SOME SAND AND WOOD DEBRIS, BROWN, SATURATED
-18.5		38			SAND AND GRAVEL, SATURATED WITH COBBLES DRILLING REFUSAL @ 18.5

Depth scale: 0, -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -20, -21, -22, -23, -24, -25, -26, -27, -28

TD = 18.5' NOTES: TRY SHELBLY AT 5'. HIT ROCK, SWITCHED TO SPT, TOO MANY ROCKS. DROVE SPT @12' - HIT WOOD - RECOVERED ~ 1', SMELLS LIKE CREOSOTE. TRY SHELBY AT 14-16 - HIT WOOD. NOTE: COBBLES THROUGHOUT HOLE

I = SHELBY TUBE ⊠ = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-3		COORDINATES OR LOCATION: LAT: 37.7055 LON: -108.0307
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:		GWL DEPTH: (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝"	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -10	-4.5 to -6 (SPT)	6 4 4	10%		RED SILTY SAND WITH GRAVEL CALCINE TAILINGS
-10 to -28	-10 to -12 (Shelby tube)		0%		NO RECOVERY. SHELBY PUSHED 24" THEN FREE FELL ANOTHER 12". DRILLED INTO VOID. BOTTOM OF AUGER AT 10'. TAPE MEASURED TO 16'. USED MIRROR TO LOOK INTO BORRING. CAVITY OPENS TO THE SOUTH. MOVING RIG TO ANOTHER LOCATION ~ 30' TO THE WEST.

TD = 10'

NOTES: DRILLER THOUGHT WE HIT VOID AT ~ 8'.

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-3R	COORDINATES OR LOCATION: LAT: 37.7054 LON: -108.0308
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 24' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -13	Shelby tube -10 to -12		75%		SILTY SAND AND GRAVEL, BROWN PIECE OF OXIDIZED MINE WASTE ROCK IN TIP OF SHELBY
-13 to -15					SANDY SILT WITH CLAY, BROWN, MOIST
-15 to -22	SPT -15 to -16.5; Shelby tube -20 to -22	3 2 2	50% 60%		OXIDIZED (RED/ORANGE/YELLOW) SAND WITH SOME SILT AND FINE GRAVEL. MOIST
-22 to -24.5					LT BROWN WET SANDY SILT. WATER
-24.5 to -25.5	SPT -25 to -26.5	10			SATURATED COARSE SAND, GRAY
-25.5 to -28		10 10	50%		SATURATED COARSE SAND AND GRAVEL; GRAY / BROWN

TD =

NOTES: 20' SHELBY - ROCK AT BOTTOM; COMPLETELY SEALED END.

I = SHELBY TUBE ⊠ = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-3R	COORDINATES OR LOCATION: LAT: 37.7054 LON: -108.0308
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 24' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
-29					SATURATED COARSE SAND AND GRAVEL; GRAY / BROWN
-30	SPT (-30 to -31.5)	10 10 13	50%		
-31					
-32					
-33					
-34					
-35	SPT (-35 to -36.5)	17 17 14	50%		
-36					
-37					
-38					
-39					
-40					
-41					
-42					
-43					
-44					
-45					
-46					
-47					
-48					
-49					
-50					
-51					
-52					
-53					
-54					
-55					
-56					
-57					

TD = 35'

NOTES:

= SHELBY TUBE

= STANDARD SPLIT SPOON (SPT)

ANDERSON ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-4	COORDINATES OR LOCATION: LAT: 37.7042 LON: -108.0301
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 11' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/7/08 DATE COMPLETED: 10/7/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -2					SILTY SAND AND GRAVEL
-2 to -3					RED SILTY GRAVEL
-3 to -7.5	-5 to -6.5 (SPT)	6 4 4	50%		SILTY SAND WITH GRAVEL, MINOR CLAY
-7.5 to -8.5					BLACK SILT WITH CLAY
-8.5 to -12.5	-10 to -11.5 (SPT)	4 3 2	75%		CLAYEY GRAVEL WATER
-12.5 to -18	-15 to -16.5 (SPT)	0 4 8	75%		SILTY GRAVEL WITH CLAY SATURATED GRAY / DK BROWN SILTY CLAY
-18 to -20					SATURATED - DK BROWN FLOWING SILT
-20 to -22.5	-20 to -21.5 (SPT)	50 / 4"	30%		SILTY SAND AND GRAVEL, DK BROWN

TD = 20.5'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-5	COORDINATES OR LOCATION: LAT: 37.7039 LON: -108.0305
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 11' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/7/08 DATE COMPLETED: 10/7/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -2					SILTY SAND AND SOME GRAVEL
-2 to -5					SANDY GRAVEL AND SILT
-5 to -14	-5 to -6.5 (SPT)	4 10 6	25%		SANDY SILT WITH GRAVEL
	-10 to -11.5 (SPT)	3 5 4	1%		HIT ROCK - NO SAMPLE RECOVERY
-14 to -18	-15 to -17 (Shelby tube)				SATURATED SILT WITH SOME MINOR SMALL GRAVEL
-18 to -22	-20 to -21.5 (SPT)	24/6 50/6	25%		SILTY SAND AND GRAVEL, SATURATED
-22 to -24					COBBLES - REFUSAL @ 23'

Depth scale: 0 to -28

TD = 23'

NOTES:

⌶ = SHELBY TUBE ⊠ = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-6		COORDINATES OR LOCATION: LAT: 37.7027 LON: -108.0305
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:		GWL DEPTH: 10' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝"	FLUID USED: N/A	DATE STARTED: 10/7/08 DATE COMPLETED: 10/7/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -3					BROWN SILTY SAND AND GRAVEL
-3 to -7	-4.5 to -6 (California split spoon)	30	50%		SANDY GRAVEL
-7 to -10					WET BROWN SANDY SILT AND GRAVEL
-10 to -15.5	-10 to -11.5 (Standard split spoon)	10 7 7	60%		SATURATED LIGHT BROWN SAND AND GRAVEL
-15.5 to -20	-15 to -17 (Shelby tube)		75%		COBBLES
-20 to -23.5	-20 to -22 (Shelby tube)		25%		TAN SATURATED SAND

TD = 25'

NOTES: ATTEMPTED SHELBY @ 15'. ROCK IN AUGER. SHELBY DESTROYED WITH NO SAMPLE RECOVERY. PUSHED OUT PLUG WITH CENTER PUNCH.

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

= CALIFORNIA SPLIT SPOON

ANDERSON
ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-7	COORDINATES OR LOCATION: LAT: 37.7018 LON: -108.0299
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 10 (ENCOUNTERED) GWL DEPTH: N/A (STATIC)

DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝"	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -7	-5 to -6.5 (SPT)	24 50 / 4"	25%		BROWN SILTY SAND AND GRAVEL WET BROWN SILTY SAND AND GRAVEL
-7 to -9					SOME CLAY PRESENT
-9 to -12	-10 to -11.5 (SPT)	35 19 34	60%		SATURATED SAND AND GRAVEL WITH SOME SILT
-12 to -15					SANDY SILT WITH GRAVEL AND COBBLES
-15 to -17	-15 to -17 (Shelby tube)		100%		SILTY SAND WITH GRAVEL
-17 to -25	-20 to -21.5 (SPT)	4 9 11	100%		SILT WITH FINE SAND, SATURATED, LIGHT BROWN

TD = 21.5'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-8	COORDINATES OR LOCATION: LAT: 37.7008 LON: -108.0301
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 6 (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0					SILTY SAND AND GRAVEL, BROWN
-5 to -6.5	⊠	9 8 29	50%		WATER, SATURATED
-7					SATURATED BROWN SANDY SILT WITH GRAVEL
-11 to -12.5	⊠	21 30 20	50%		COBBLES AND BOULDERS REFUSAL @ 12'

Depth scale: 0, -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -20, -21, -22, -23, -24, -25, -26, -27, -28

TD = 12'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-9	COORDINATES OR LOCATION: LAT: 37.7062 LON: -108.0314
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: ~ 17' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/8/08 DATE COMPLETED: 10/8/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	DESCRIPTION
0				RED SILTY SAND; CALCINE TAILINGS
-1				
-2				
-3				
-4				
-5	Shelby tube			
-6			100%	
-7				
-8				
-9				
-10	Standard split spoon	4		
-11		4 4	70%	THIN LAYER OF GRAY SATURATED SILT @ 11'
-12				
-13				RED SILTY SAND, CALCINE TAILINGS
-14				
-15	Shelby tube			
-16			100%	
-17				SAND AND GRAVEL - SATURATED, BLACK
-18				
-19				
-20	Standard split spoon	12		
-21		24 30	50%	REFUSAL @ 23.5'
-22				
-23				
-24				
-25				
-26				
-27				
-28				

TD = 23.5'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON

ANDERSON
ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-10	COORDINATES OR LOCATION: LAT: 37.7046 LON: -108.0308
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: ~ 13' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/7/08 DATE COMPLETED: 10/7/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -4					BROWN SILTY SAND AND GRAVEL
-4 to -13	-5 to -7 (Shelby tube); -9 to -11 (Shelby tube)		<25% (-5 to -7); 33% (-9 to -11)		BROWN CLAYEY SILT WITH MINOR GRAVEL
-13 to -14					SATURATED DARK BROWN - GRAY SILT WITH MINOR GRAVEL
-14 to -17	-14 to -15.5 (SPT)	10 26 50 / 2	<25%		SATURATED BROWN SAND AND GRAVEL, SOME MINOR SILT ROCK ENCOUNTERED AT 17' REFUSAL @ 17'

TD = 17'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-11	COORDINATES OR LOCATION: LAT: 37.7063 LON: -108.0308
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: ~ 20 (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/8/08 DATE COMPLETED: 10/8/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -4.5	Shelby tube -2.5 to -4.5		70%		BROWN CLAYEY SILT, MOIST MINOR GRAVEL
-4.5 to -16.5	Shelby tube -5 to -7		100%		RED SILTY SAND, CALCINE TAILINGS
	Shelby tube -7.5 to -9.5		100%		
	Shelby tube -12.5 to -14.5		100%		
	Shelby tube -15 to -17		100%		
-16.5 to -20.5	Shelby tube -17.5 to -19.5		100%		RED SILT - CALCINE TAILINGS
-20.5 to -21	SPT -20 to -21.5	27 50 / 1"	50%		SAND AND GRAVEL, SATURATED RED / BROWN WITH COBBLES REFUSAL @ 21'

Depth scale: 0, -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -20, -21, -22, -23, -24, -25, -26, -27, -20

TD = 21'

NOTES: ATTEMPTED SHELBY @ 10'; 0 RECOVERY

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-12R	COORDINATES OR LOCATION: LAT: 37.7073 LON: -108.0297
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 43' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: ODEX	HOLE DIA: 6" / FLUID USED: AIR	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -5					BROWN SANDY SILT WITH SOME CLAY AND GRAVEL
-5 to -9					BROWN CLAYEY SILT WITH SOME SAND AND SMALL GRAVEL
-9 to -11					ROCK
-11 to -12.5					RED SILTY SAND WITH GRAVEL, CALCINE TAILINGS
-12.5 to -22	-13 to -14.5 (SPT)	6 4 4	50%		BROWN SANDY SILT WITH SOME CLAY AND GRAVEL
-22 to -28					BROWN SANDY SILT WITH GRAVEL

TD =

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-12R	COORDINATES OR LOCATION: LAT: 37.7073 LON: -108.0297
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 43' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: ODEX	HOLE DIA: 6" / FLUID USED: AIR	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	PROFILE	DESCRIPTION
-29 to -33				
-33 to -37				SANDY SILT AND GRAVEL, MINOR CLAY
-37 to -39				ROCK
-39 to -41				SANDY SILT AND GRAVEL, MINOR CLAY
-41 to -43				RED COBBLES WITH SOME SILT AND SAND
-43 to -46				GRAVEL WITH SOME SILT
-46 to -47				SILTY GRAVEL
-47 to -50				CLAYEY SILT WITH MINOR GRAVEL, MOIST - WET
-50 to -55				SANDY GRAVEL WITH SOME SILT, MOIST. HARDER DRILLING
-55 to -57				TD

TD = 55' NOTES: SOME GRAVEL IS CRUSHED ROCK FROM ODEX HAMMER HIT. UNKNOWN ORIGINAL SIZE.

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-13	COORDINATES OR LOCATION: LAT: 37.7033 LON: -108.0305
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 8' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: ODEX	HOLE DIA: 6" / FLUID USED: AIR	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -5					BROWN SILT AND SAND WITH SOME GRAVEL
-5 to -7					WOOD DEBRIS
-7 to -8.5					SILTY SAND AND GRAVEL, MOIST, BROWN
-8.5 to -16					SATURATED SILTY SAND AND GRAVEL, BROWN
-16 to -18					SATURATED LIGHT BROWN SILTY GRAVEL
-18 to -28					SATURATED LIGHT BROWN SILTY SAND GRADES MORE SILTY (at -21)

TD =

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-13	COORDINATES OR LOCATION: LAT: 37.7033 LON: -108.0305
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 8' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: ODEX	HOLE DIA: 6" / FLUID USED: AIR	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
-29					
-30					
-31					
-32					
-33					
-34					
-35					
-36					
-37					
-38					
-39					
-40					
-41					
-42					
-43					
-44					
-45					
-46					
-47					
-48					LESS SILTY
-49					
-50					
-51					
-52					
-53					
-54					
-55					TD
-56					
-57					

TD = 55'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON ENGINEERING COMPANY, INC.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name: St. Louis Ponds Area, Rico, Colorado			License/Permit/Monitoring Number: AARCOE0105.00		Boring Number: EW-1
Boring Drilled By: Name of crew chief (first, last) and Firm: Jeff Pennell, Layne-Western			Date Drilling Started: 11/20/2004	Date Drilling Completed: 11/21/2004	Drilling Method: odex
WI Unique Well No.	DNR Well ID No.	Common Well Name: EW-1	Final Static Water Level: Feet Site	Surface Elevation: 8,850.5 Feet Site	Borehole Diameter: 5.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ° ' "
Long ° ' "
Local Grid Location: 1389193 Feet ☒ N ☐ S; 2268176 Feet ☒ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24	17-20 15-11		FILL: Brown, dense, GRAVELLY SAND, some organics in surface soils.					35					Note: Compressive Strength = SPT N value
2 SS	24	5-7 7-7	2	Brown, medium dense, fine to coarse grained CLAYEY SAND, with gravel.	SC				14					Note: Length att. on split spoon = 24"
3 SS	24	5-11 5-2	4–6						16					
4 SS	24	4-4 6-3	8	Brown, loose, fine to coarse grained, CLAYEY SAND.	SC				10					
5 SS	24	2-8 4-5	10	Brown, loose to very dense, fine to coarse grained, CLAYEY SAND and gravel	SC				12					
1 SH	6		12											approx. 6 inches recovery
6 SS	24	5-4 2-4	14						6					
2 SH	24		16											
7 SS	24	6-8 10-8	18						18					
			20											
8 SS	24	50	22–24	Brown-gray, very dense, fine-coarse GRAVEL, with sand and clay	GP				50					

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Daniel R. Reed

Firm: **SEH Inc** 421 Frenette Drive, Chippewa Falls, WI 54729, www.sehinc.com
Tel: 715.720.6200
Fax: 715.720.6300

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number EW-1 Use only as an attachment to Form 4400-122.

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			26	Brown-gray, very dense, fine-coarse GRAVEL, with sand and clay	GP									
			28	End of boring at 28' (refusal)										

State of Wisconsin
Depanmem of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewaier ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EW-2A

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Westem	11/21/2004	11/21/2004	odex

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			Feet Site	8,846.4 Feet Site	5.0 inches

Local Grid Origin ☒ (estimated: ☐) or Bormg Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lai ___° ___' ___"
Long ___° ___' ___"
Local Grid Location
1389198 Feet ☒ N ☐ S
2268004 Feet ☒ E ☐ W

Facility ID	County	Counry Code	Civil Town/City/ or Village
			Rico, Colorado

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24	1-3 12-9		FILL: Brown, dense, GRAVELLY SAND, some organics in surface soils.					15					Note: Compressive Strength = SPT N value
2 SS	24	3-7 4-5	2	Brown, loose, fine to coarse grained CLAYEY SAND, with gravel.	SC				11					Note: Length att. on split spoon = 24"
3 SS	24		4 6	Brown, loose, SANDY CLAY to clayey sand, with gravel.	CL									
4 SS	24	3-4 3-3	8	Brown, medium stiff, SANDY CLAY, with gravel	CL-ML				7					
5 SS	24	5-8 8-17	10	Brown, stiff, SANDY CLAY to clayey sand, with gravel	CL-ML				16					
			12	End of boring at 12' (abandoned)										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Daniel R. Reed

Firm **SEH Inc** 421 Frenetic Drive Chippewa Falls, WI 54729 www.sehinc.com Tel: 715.720.6200 Fax: 715.720.6300

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122 Rev. 7-98

Route To. Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EB-1

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Western	11/15/2004	11/18/2004	hsa/odex

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		EB-1	8,820.9 Feet Site	8,837.9 Feet Site	8.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ° ' "
Long ° ' "
Local Grid Location: 1388792 Feet ☒ N ☐ S; 2267917 Feet ☒ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24	29-44 18-14		FILL: Gray, very dense, WASTE ROCK, igneous cobbles					62					Note: Compressive Strength = SPT N value Note: Length alt. on split spoon = 24"
2 SS	24	5-8 8-12	2	FILL ("Calcine Tailings"): Purple-maroon to gray, loose to medium dense, fine to very fine grained, SILTY SAND, rare gravel					16					
3 SS	24	4-9 8-11	4						17					
4 SS	24	5-5 7-7	6						12					
1 SH	24		8											
2 SH	24		10											
4 SS	24	5-4 4-3	12		SM				8					
3 SH	24		14											
5 SS	24	2-2 6-16	16						8					
4 SH	24		18											
6 SS	24	12-7 9-7	20						16					
5 SH	24		22											
			24		GP									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Daniel R. Reed

Firm **SEH Inc** 421 Frenette Drive Chippewa Falls, WI 54729 www.sehinc.com Tel: 715.720.6200 Fax: 715.720.6300

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number EB-1 Use only as an attachment to Form 4400-122. Page 2 of 2

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			26	Brown, dense, fine to coarse **GRAVEL** (alluvium), much fine to coarse grained sand.										
7 SS	24	22-20 24-50	28		GP				44					
			30											
			32											
				End of boring at 33' (refusal)										

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EB-2

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Western	11/19/2004	11/19/2004	hollow stem auger

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		EB-2	8,818.8 Feet Site	8,826.8 Feet Site	8.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E
Feet ☐ S Feet ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				FILL: Gray, very dense, WASTE ROCK, igneous cobbles										
1 SS	24	4-6 4-7	2	FILL("Calcine Tailings"): Purple-maroon to gray, loose to medium dense, fine to very fine grained. SILTY SAND, rare gravel	SM				10					Note: Compressive Strength = SPT N value Note: Length att. on split spoon = 24"
2 SS	24	4-4 5-4	4						9					
3 SS	24	3-3 6-3	6						9					
4 SS	24	3-2 1-1	8						3					
			10											
			12											
5 SS	24	1-1 1-1	14						2					
			16											
			18	Brown, dense, fine to coarse GRAVEL (alluvium), much fine to coarse grained sand.	GP									
6 SS	24	12-24 50	20						74					
			22											
			24	End of boring at 24'										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Daniel R. Reed

Firm SEH Inc 421 Frenette Drive Chippewa Falls, WI 54729 www.sehinc.com Tel: 715.720.6200 Fax: 715.720.6300

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Depanmem of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershcd/Wastewatcr ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EB-2D

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Western	11/18/2004	11/19/2004	odex

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			Feet Site	8,826.0 Feet Site	5.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ___° ___' ___"
Long ___° ___' ___"
Local Grid Location: 1388306 Feet ☒ N ☐ S; 2267920 Feet ☒ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–1	FILL: Gray, very dense, WASTE ROCK, igneous cobbles										
			1–18	FILL ("Calcine Tailings"): Purple-maroon to gray, loose to medium dense, fine to very fine grained, SILTY SAND, rare gravel	SM									Note: Compressive Strength = SPT N value Note: Length att. on split spoon = 24" 3" diameter split spoon used (no shelby rcc)
1 SH	24		3–5											
2 SH	24		5–7											
1 SS	24		7–9											
3 SH	24		9–11											
4 SH	24		11–13											
2 SS	24	4-1 1-4	15–17						2					
			18–24	Brown, dense, fine to coarse GRAVEL (alluvium), much fine to coarse grained sand.	GP									

I hereby certify that the mformation on this form is true and correct to the best of my knowledge.

Signature: Daniel R. Reed
Firm: SEH Inc, 421 Frenene Drive, Chippewa Falls, WI 54729, www.sehinc.com
Tel: 715.720.6200
Fax: 715.720.6300

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number EB-2D   Use only as an attachment to Form 4400-122.

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				End of boring at 24' (abandoned - moved to EB-2, approx. 10' to east)										

CDPHE

Colorado Department of Public Health and Environment

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW1	Well Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kaventa Consulting		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 4ft. To 9 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^{w}):	9 ft.	Depth to Water Before Development (L^{i}):	6.5 ft.
Height of Water Column (L^{w} - L^{i}):	6 ft.		
Depth to Top of Sediment (L^{s})	9 ft.	Sediment Thickness (L^{w} - L^{s}):	Na ft.
Well Volume:	0.96 gal.		
Total Volume Pumped:	30 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	30+ volumes pumped on 10/16/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW1

Date	Temp	pH	Cond	Gallons Purged	Observations
10/16/02	11.2	7.37	359	27	Slightly turbid
10/16/02	10.8	7.36	359	29	Clear, Slightly turbid

* Sample collection continued after well development includes well development purge volumes

10/16/02 @ 1345	Sample Collected

Lithology

0-9 feet	Native rocky cobble material

Presented By	Date	Checked By	Date

CDPHE Colorado Department of Public Health and Environment

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW2	Well Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kaventa Consultine		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 10.5 ft. To 20.5 ft bgs		Well Diameter:	2 Inch
Depth of Well (L"):	20.5 ft.	Depth to Water Before Development (L'):	6.5 ft
Height of Water Column (L" - L'):	2.0 ft.		
Depth to Top of Sediment (L'):	20.5 ft.	Sediment Thickness (L" - L'):	Na ft.
Well Volume:	0.32 gal.		
Total Volume Pumped:	5 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	4x volumes pumped on 10/16/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW2

Date	Temp	pH	Good	Gallons Purged	Observatinns
10/16/02	11.9	7.29	1004	Purged dry four times	Clear
				Total of 5 gallons max	

* Sample collection continued after well development includes well development purge volumes

10/16/02 @ 1620	Sample Collected

Lithology

0-12 feet	Spent pyretic ore with mixed coble and rock. Ore materials are green and purple in color. Lench pad liner at 12 feel bgs
12-20.5 feet	Native rocky cobble material

Preseated By	Date	Chtelred By	Date

CDPHE	WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY
Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW3	Well Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 7 ft. To 16.5 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^*):	16.5 ft.	Depth to Water Before Development (L^1):	6.5 ft.
Height of Water Column ($L^* - L^1$):	9.5 ft.		
Depth to Top of Sediment (L^s)	16.5 ft.	Sediment Thickness ($L^* - L^s$):	Na ft.
Well Volume:	1.12 gal.		
Total Volume Pumped:	15 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	14 volumes pumped on 10/16/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW3

Date	Temp	pH	Cond	Gallons Purged	Observations
10/16/02	11.6	6.46	1526	5	Slightly turbid
10/16/02	10.9	6.45	1529	7	Slightly turbid
10/16/02	10.6	6.44	1484	8	Slightly turbid
10/16/02	10.8	6.42	1512	9	Clear, Slightly turbid

* Sample collection continued after well development includes well development purge volumes

10/16/02 @ 1100	Sample Collected

Lithology

0-3.5 feet	Spent pyretic ore with mixed coble and rock.
3.5-16.5 feet	Native rocky cobble material

Presented By	Date	Checked By	Date

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CDPHE

Colorado Department of Public Health and Environment

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW4	Well Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 4ft. To 14 ft bgs		Well Diameter:	2 Inch
Depth of Well (L*):	14 ft.	Depth to Water Before Development (L'):	7 ft.
Height of Water Column (L* - L'):	7 ft.		
Depth to Top of Sediment (L')	14ft.	Sediment Thickness (L* - L'):	Na ft.
Well Volume:	1.12 gal.		
Total Volume Pumped:	27 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	25+ volumes pumped on 10/16/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW4

Date	Temp	pH	Cond	Gallons Porged	Observations
10/16/02	14.0	7.20	1385	24	Slightly turbid
10/16/02	13.5	7.20	1380	25	Slightly turbid
	13.7	7.20	1383	27	Slightly turbid

* Sample collection continued after well development includes well development purge volumes

10/16/02 @ 1600 — Sample Collected

Lithology

0-2 feet bgs	Gravel fill material
2-14 feel bgs	Rip tap materials and cobble

Presented By	Date	Checked By	Date

CDPHE
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW5	Well Location: Rico Light Industrial Park

Time / Date:	10/17/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Dale Development Started:	10/17/02	Date Development Completed:	10/17/02
Screen Intervals: 18 ft. to 23 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^*):	23 ft	Depth to Water Before Development (L'):	15 ft.
Height of Water Column ($L^* - L'$):	8 ft		
Depth lo Top of Sediment (L')	14ft.	Sediment Thickness ($L^* - L'$):	Na ft
Well Volume:	1.28 gal.		
Total Volume Pumped:	46 gal.		
Number of Well Volumes Pmnped	(total volume pumped/well volume):	46 gallons purged on 10/17/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW5

Date	Temp	pH	Cond	Gallons Purged	Observations
10/17/02	13.8	6.89	2620	45	Slightly tmbid
10/17/02	13.4	6.90	2620	45.5	Clear, Slightly turbid
	13.7	6.91	2610	46	Clear

* Sample collection continued after well development includes well development purge vohnnes

10/17/02 @ 1145	Sample Collected

Lithology

0-2 feet bgs	Waste rock materials
2-23 feet bgs	Purple toasted tailings, wet

Presented By	Date	Checked By	Date

CDPHE	WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW6	Well Location: Rico Light Industrial Park

Time / Date:	10/17/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/17/02	Date Development Completed:	10/17/02
Screen Intervals: 12 ft. to 17 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^*):	30 ft.	Depth to Water Before Development (L^l):	25 ft.
Height of Water Column ($L^* - L^l$):	5 ft.		
Depth to Top of Sediment (L^l)	30ft.	Sediment Thickness ($L^* - L^l$):	Na ft.
Well Volume:	0.8 gal.		
Total Volume Pumped:	8 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	8+ volumespurged on 10/17/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW6

Date	Temp	pH	Cond	Gallons Purged	Observations
10/17/02	13.1	6.49	4000	6	Slightly turbid
10/17/02	12.6	6.38	3970	7	Ckar, Slighlly turbid
10/17/02	13.1	6.42	4110	8	Clear
			* Purged dry total of 8 times, Collected sample on 9th recharge		

* Sample collection continued after well development includes well development purge volumes

10/17/02 @ 1645	Sample Collected

Lithology

0-18 feet bgs	Purple roasted tailings mixed with waste rock and river cobble
18-30 feet bgs	Native Rock, Cobble

Presented By	Date	Checked By	Date

CDPHE Colorado Department of Public Health and Environment 4300 Cherry Creek Drive South Denver, CO 80246	**WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY**	[illegible]

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-OW7	Well Location: Rico Light Industrial Parik

Time / Date:	10/17/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kaventa Consulting		Slight Breeze
Date Development Started:	10/17/02	Date Development Completed:	10/17/02
Screen Intervals: 19 ft. to 24 ft bgs		Well Diameter:	2 hich
Depth of Well (L^w):	24 ft.	Depth to Water Before Development (L^i):	19 ft.
Height of Water Column ($L^w - L^i$):	5 it.		
Depth to Top of Sediment (L^i)	24 ft.	Sediment Thickness ($L^w - L^i$):	Na ft.
Well Volume:	0.8 gal.		
Tolal Volume Fumpe6:	35 gal.		
Number of Well Volumes Pumped	(total vohime pumped/well vohime):	43+ volumes purged on 10/17/02	0.16 gallons per foot on a 2-tnch Well

Monitoring Well Sample Data : Well RLP-GW7

Date	Temp	pH	Cond	Gallons Purged	Observations
10/17/02	15.5	6.51	1679	26	Sllghtly tmbid
10/17/02	15.7	6.51	1719	35	Clear

* Sample collection continued after well development includes well development purge volumes

10/17/02 @ 1550	Sanple Collecled

Lithology

0-24 feet bgs	Wasle rock / river cobble

Presented By	Date	Cheeked By	Date

CDPHE

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW8	Well Location: Rico Light Industrial Park

Time / Date:	10/17/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kavenla Consulting		Slight Breeze
Date Development Started:	10/17/02	Date Development Completed:	10/17/02
Screen Intervals: 25 ft. to 30 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^w):	30 ft.	Depth to Water Before Development (L^t):	25 ft.
Height of Water Column (L^w - L^t):	5 ft.		
Depth to Top of Sedhnent (L^s)	30 ft.	Sediment Thickness (L^w - L^s):	Na ft.
Well Volume:	0 8 gal.		
Total Volume Pumped:	24 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	24+ volumes pureed on 10/17/02	0.16 gallons per foot on a 2-Ineh Well

Monitoring Well Sample Data : Well RLP-GW8

Date	Temp	pH	Cond	Gallons Pnrged	Observations
10/17/02	13.0	6.46	2510	22	Clear, Slightly tuibid
10/17/02	12.9	6.58	2520	23	Clear, Slightly turbid
10/17/02	12.5	6.64	2520	24	Clear, Shghlly turbid

* Sample collection continued after well development includes well development purge volumes

10/17/02 @ 1735	Sample Collected

Lithology

0-1 feet bgs	Fill material
1-24 feet bgs	Red purple slimes, roasted tailings, saturated
24 – 30 feet bgs	Native materials, river cobble

Presented By	Date	Checked By	Date

BORING B-1

SURFACE ELEVATION 8533
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
												0
										15	SPT	5
										9	SPT	10
										7	SPT	15
				14						13	SPT	20
										18	D	25
										21	SPT	30
										50/5"	SPT	
												35
												40
												45
												50
												55
												60
												65
												70

SYMBOLS — DESCRIPTION

GM — BROWN FINE TO COARSE SANDY GRAVEL WITH SILT MEDIUM DENSE

GRADES WITH LENSES OF SILTY SAND AND SANDY SILT

COLOUR GREY AND GRADES WITH SOME CLAY BECOMES LOOSE TO MEDIUM DENSE

GRADES LOOSE

GRADES WITH MORE GRAVEL AND MEDIUM DENSE

FILL (0 to ~21.5 feet)

GM — DARK BROWN TO BLACK SILTY GRAVEL WITH SAND, MEDIUM DENSE

SM — BROWN SILTY FINE TO COARSE SAND WITH SOME GRAVEL MEDIUM DENSE

GM — BROWN SANDY GRAVEL, DENSE TO VERY DENSE

AUGER REFUSAL AT 33 FEET
BORING COMPLETED AT 33.5 FEET ON 6/3/81
WATER ENCOUNTERED AT 21.5 FEET ON 6/3/81

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ◪ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:

1. THE SOIL CONDITIONS ARE DESCRIBED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM, PLATE A-3.
2. BLOW COUNT HAS BEEN TAKEN AS THE NUMBER OF BLOWS REQUIRED TO DRIVE A SAMPLER TO ONE-FOOT PENETRATION USING A 140 POUND WEIGHT FALLING 30 INCHES.

LOG OF BORING

DAMES & MOORE

FILE ANACONDA RICO 04010-002-1608

BORING B-2

SURFACE ELEVATION 8834
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
												0
										28	SPT	5
GRADATTON				22			32	17	15	8	SPT	10
										12	SPT	15
										21	SPT	20
						67	67	51	16	5	SPT	25
						66				11	SPT	
										50 for 1/4"	SPT	30
												35
												40
												45
												50
												55
												60
												65
												70

SAMPLING

SYMBOLS	DESCRIPTION
SC	SBOWN CLATET SAND UITN GRAVEL MEDIUM DENSE
SM	BROWN AND GREY ORAVELLY SANS NITN SOME CLAT
SC	TELLOW AND BROUB ETNE TO COARSE CLATET SAND WITH GRAVEL LOOSE
	LUMBER FRAGMENTS AT 15 FEET GRADES MEDIUM DENSE
GM	SRET E BROUN SANDY GRAVEL NITH SOME SILT NEDIUM DENSE
MH	DANK BROWB AND BLACK FINE SANOT SILT SOFT TO MPLIUM STIFT

FILL (0 to 22.5 feet)

AUGER REFUSAL AT 30.5 FEET
BORING COMPLETEO AT 30.5 FEET ON 6/4/81
WATER ENCOUNTERED AT 20.7 FEET ON 6/3/81

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ☒ IMPICATES DISTURBED SAMPLE
- □ INDICATES SAMPLINS ATTEMPT WITH NO RECOVCRY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOOPE "D" SAMPLER

NOTE:
SEE PLATE A - 1A.

LOG OF BORING

DAMES & MOORE

FILE ANACONDA RICO 01010-082-1605

BORING B-3

SURFACE ELEVATION 8836
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
												0
				42						6	SPT	5
										32	SPT	10
										7	SPT	15
										23	SPT	20
												25
												30

SYMBOLS — DESCRIPTION

- 0 ft (GC): BROWN SANDY CLAYEY GRAVEL WITH SAND, LOOSE
- 5 ft: SAMPLER DRIVEN THROUGH COBBLE
- 10 ft: GRADES MEDIUM DENSE
- 0–20 ft: FILL
- 20 ft: AUGER REFUSAL AT 20'
  BORING COMPLETED AT 20 FEET ON 6/5/81
  NO WATER ENCOUNTERED

BORING B-4

SURFACE ELEVATION 8835
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
												0
										5	SPT	5
GRADATION				22		15	27	21	6	5	SPT	10
												15
										1	SPT	20
												25
												30

SYMBOLS — DESCRIPTION

- 0 ft (SC-GC): BROWN CLAYEY SAND AND GRAVEL WITH COBBLES LOOSE
- 0–20 ft: FILL
- 20 ft (CL): DARK BROWN SILTY AND SANDY CLAY WITH ORGANIC MATERIAL
- AUGER REFUSAL AT 24.5 FEET
  BORING COMPLETED AT 24.5 FEET ON 8/5/81
  NO WATER ENCOUNTERED

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:
SEE PLATE A - 1A.

LOG OF BORING

DAMES & MOORE

FILE ANACONDA RICO 04010-082-1608

BORING B-5

SURFACE ELEVATION 8839
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	STRENGTH TEST RESULTS: CONFINING PRESSURE (psf)	STRENGTH TEST RESULTS: PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	ATTERBERG LIMITS: PL (%)	ATTERBERG LIMITS: PI (%)	SAMPLING: BLOW COUNT	SAMPLING: SAMPLE TYPE	DEPTH IN FEET
pH, SULFATES						5	31	20	11	11	SPT	5
										11	SPT	10
										32	SPT	15
				43						11	SPT	20
						13	44	23	21	[illegible]	SPT	25
										50 for 4 1/2"	SPT	30
												35

SYMBOLS — DESCRIPTION

- 0 ft (CL): BROWN SANDY CLAY WITH SOME GRAVEL STIFF
- 15 ft: GRADES WITH MORE GRAVEL
- ~19 ft (SM): YELLOW-BROWN GRAVELLY SAND WITH SOME CLAY AND WOOD FRAGMENTS LOOSE TO MEDIUM DENSE
- 25 ft (CL): DARK BROWN SANDY CLAY
- AUGER REFUSAL AT 29.5 FEET
  WEATHERED SANDSTONE BEDROCK
  BORING COMPLETED AT 30.25 FEET ON 6/6/81
  WATER ENCOUNTERED AT 25.5 FEET ON 6/5/81

FILL (0 to 25 ft)

BORING B-6

SURFACE ELEVATION 8733
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	STRENGTH TEST RESULTS: CONFINING PRESSURE (psf)	STRENGTH TEST RESULTS: PEAK SHEAR STRENGTH (psf)	% PASSING NO 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	ATTERBERG LIMITS: PL (%)	ATTERBERG LIMITS: PI (%)	SAMPLING: BLOW COUNT	SAMPLING: SAMPLE TYPE	DEPTH IN FEET
										2/4"	SPT	0
				25			28	18	7	5	SPT	5
										50/0"	SPT	10
												15
												20
												25

SYMBOLS — DESCRIPTION

- 0 ft (SM): DARK BROWN SILTY SAND WITH GRAVEL AND COBBLES MEDIUM DENSE
- (CL, ML): DARK BROWN CLAYEY SILT AND SILTY CLAY WITH GRAVEL AND COBBLES MEDIUM STIFF
- AUGER REFUSAL AT 10 FEET
  BORING COMPLETED AT 11 FEET ON 8/7/81
  WATER ENCOUNTERED AT 5 FEET ON 8/7/81

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:
SEE PLATE A - 1A.

LOG OF BORING

DAMES & MOORE

FILE ANACONDA RICO 09010-082-16010

BORING B-7

SURFACE ELEVATION 6606
COORDINATES

DEPTH IN FEET	OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE
0												
5											7	SPT
10											9	SPT
15											33	SPT
20												
25												
30												

SYMBOLS / DESCRIPTION

GM — BRSWN AND GREY SANDY GRAVEL WITH SOME SILT LOOSE

SC — BROWN CLAYEY SAND WITH GRAVEL LOOSE TO MEDIUM DENSE

GM — BROWN SANDY GRAVEL WITH SILT MEDIUM DENSE TO DENSE

AUGER REFUSAL AT 17.5 FEET
BORING COMPLETRO AT 17.5 FEET
ON 6/7/81
UATRR LEVEL ENCOUNTTRED AT 15 FEET

BORING B-8

SURFACE ELEVATION SS[illegible]
COORDINATES

DEPTH IN FEET	OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE
0												
5											2	SPT
10	GRADATION				ID						25/6"	SPT
15												
20												
25												
30												

SYMBOLS / DESCRIPTION

SM — BROWN SILTY FINE TO COARSE SAND WITH SOME GRAVEL LOOSE TO MEDIUM DENSE

ML — DARK BROWN CLAYEY SILT WITH SAND

GM — BROWN SANDY FINE OAIO. WITH CLAY

AUSER REFUSAL AT 12 FEET
BORING COMPLETED AT 12 FEET
BM 8/7/81
WATER LEVEL ENCOUNTERED AT 9 FEET
ON 6/7/81

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ▦ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:
SEE PLATE A - 1A.

Added 2/19/07

LOG OF BORING

DAMES & MOORE

PLATE A-1E

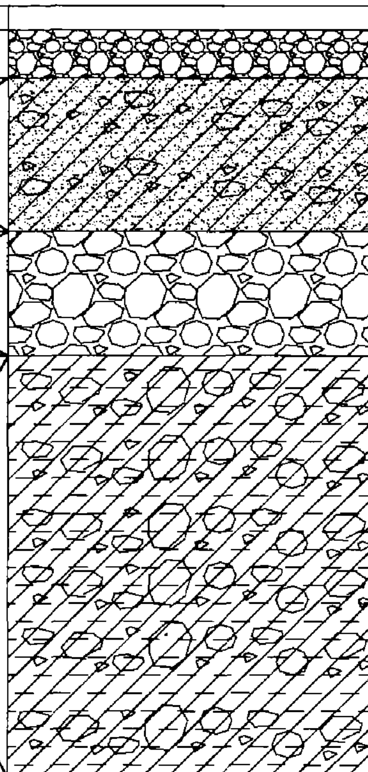
Test Pit Logs

- Anderson Engineering / SEH, 2008
- SEH, 2004
- SEH, 2001
- Anderson Engineering, 1996

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-1	COORDINATES OR LOCATION: LAT: 37.7075 LON: -108.0321
LOGGED BY: OS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 7.8' (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -0.5			GRAVEL ON SURFACE WITH ROAD BASE COURSE
-0.5 to -2.0	X		DARK BROWN SILTY SAND WITH GRAVEL
-2.0 to -3.5	X		RED TAILINGS (CALCINE) WITH GRAVEL AND ROCK (2" - 8") APPROX 20-25% ROCK
-3.5 to -7.8	X		DARK BROWN CLAY SILT WITH GRAVEL AND ROCK (2" - 12") APPROX 10 - 12% ROCK, MOIST CAVITY AT 7.0' DUE TO FOCK FALL, WATER ENCOUNTERED AT 7.8'



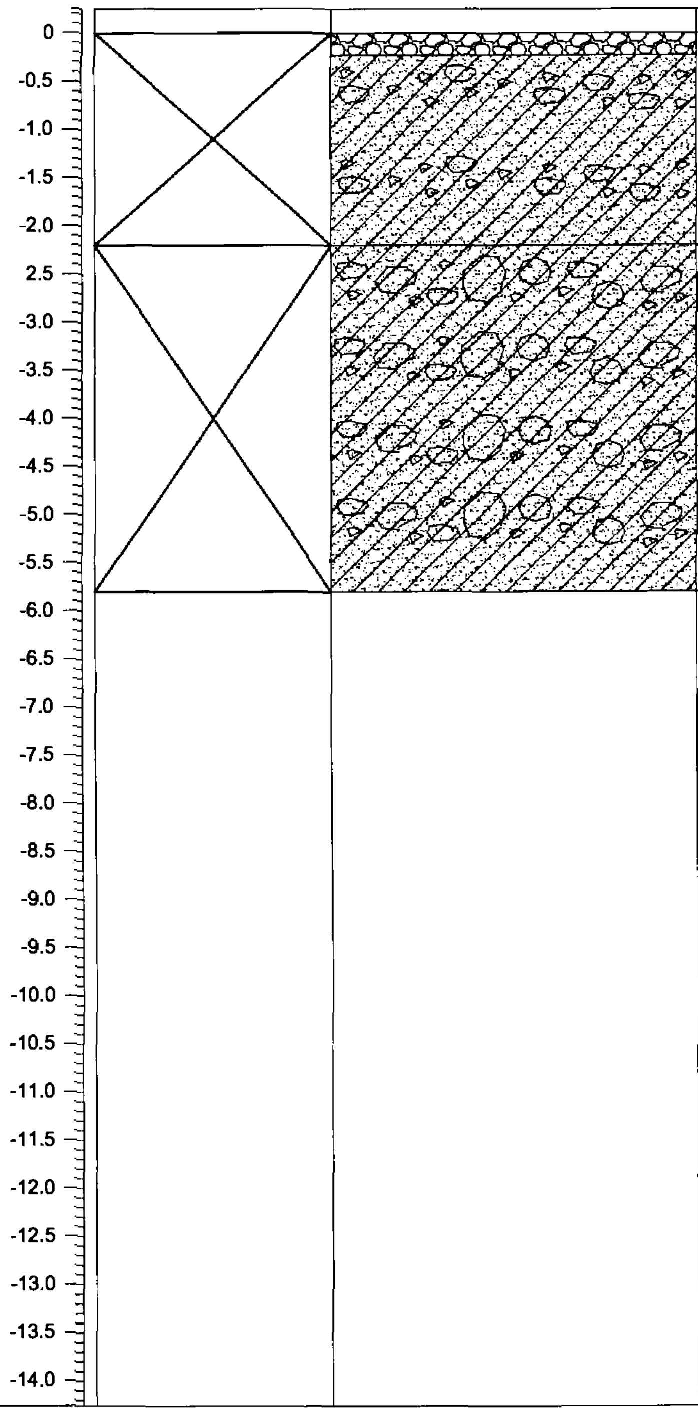
Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 7.8' NOTES: PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
ENGINEERING COMPANY, INC.

TEST PIT LOG			PAGE 1 OF 1
SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-2	COORDINATES OR LOCATION:	LAT: 37.7063 LON: -108.0321
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08

DEPTH (FT) | SAMPLE DEPTH INTERVAL | PROFILE | DESCRIPTION



GRAVEL ON SURFACE
DARK BROWN, SILTY SAND WITH MINOR GRAVEL

BROWN SANDY SILT SOIL WITH GRAVEL AND ROCK (2" TO 14" DIAMETER), MOIST, APPROX 10 TO 12% ROCK

TRENCH CAVE IN ON SIDE WALLS

TD = 6.0' NOTES: DID NOT CONTINUE DUE TO TRENCH CAVE IN ON SIDE WALLS
X = SAMPLE, BACKFILLED AND COMPACTED

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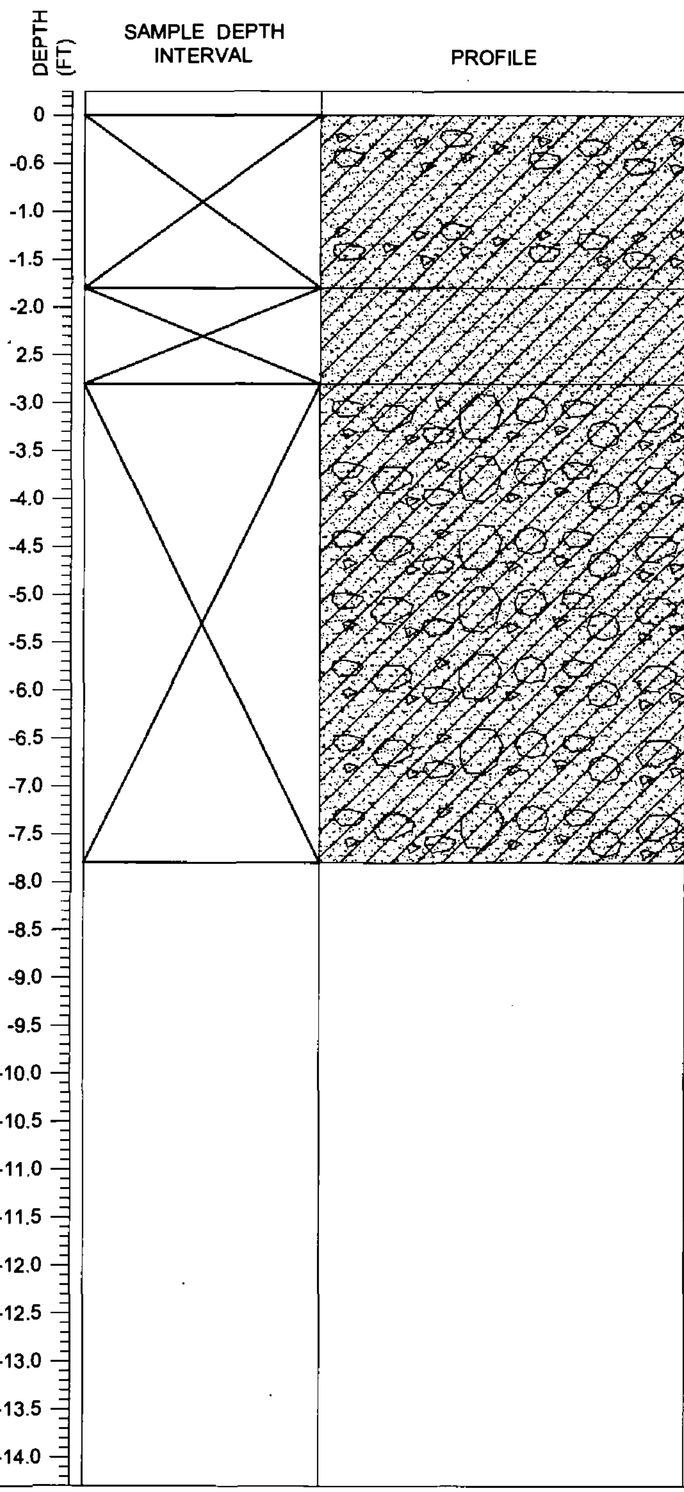
TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-3	COORDINATES OR LOCATION:	LAT: 37.7054 LON: -108.0317
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION: .	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08



DESCRIPTION

SURFACE GRAVEL ¾"
SANDY SILT, DARK BROWN SOIL, MINOR AMOUNTS OF GRAVEL

SILTY SAND, REDISH BROWN, MIXED SOIL AND TAILINGS (CALCINE)

SANDY SILT, BROWN WITH GRAVEL, MOIST, SOME LARGE ROCK (6" - 12" DIAMETER) MOIST

TD = 7.8' NOTES: NO WATER, TEST PIT BACKFILLED, COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF INTERVAL

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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-4	COORDINATES OR LOCATION: LAT: 37.7054 LON: -108.0312
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 7.8' (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -0.7			GRAVEL ON SURFACE, SILTY SAND, DARK BROWN CLAY, MINOR AMOUNTS OF TAILINGS
-0.7 to -1.5	X		SANDY SILT WITH MINOR GRAVEL, LIGHT BROWN
-1.5 to -4.5	X		CLAY SILT WITH MINOR SAND, BROWN SOIL ON GRAVEL, MOIST
-4.5 to -7.8	X		CLAY SILT WITH MINOR SAND WITH GRAVEL, DARK BROWN, SOME TAILINGS MIXED WITH SOIL, MOIST AT TOP, WET AT 7.5'

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD ≈ 7.8' NOTES: WATER; BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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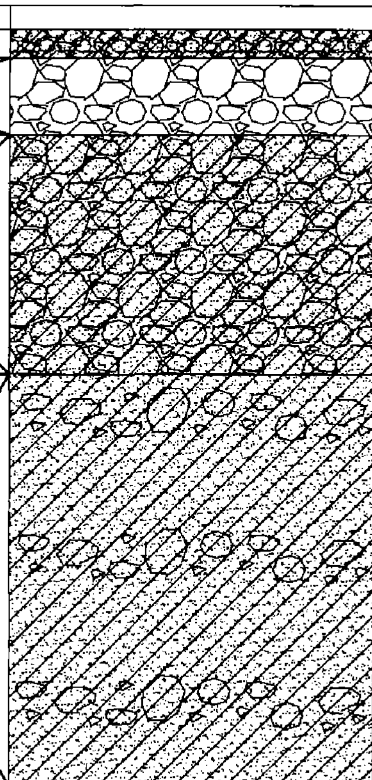
TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-5	COORDINATES OR LOCATION:	LAT: 37.7054 LON: -108.0305
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0	X		GRAVEL ON SURFACE UNDERLAING BY DK BROWN SILTY SAND
-0.5	X		YELLOW BROWN MINE WASTE WITH GRAVEL AND ROCK (2" - 6" DIAMETER), 70% ROCK
-1.0 to -3.5	X		BROWN SOIL MIXED WITH RED CALCINE TAILINGS, SILTY SAND CONTAINS GRAVEL AND ROCK (2" TO 12" DIAMETER) APPROX 20-30% ROCK
-3.5 to -8.0	X		BROWN SOIL, SILTY SAND MIXED WITH CALCINE TAILINGS, MINOR GRAVEL AND SOME ROCK, APPROX 5% ROCK

Depth scale (FT): 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 7.9' NOTES: TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-6	COORDINATES OR LOCATION:	LAT: 37.7041 LON: -108.0311
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 -0.5 -1.0 -1.5	X		GRAVEL ON SURFACE, DARK GRAY SOIL WITH WASTE ROCK, GRAY IN COLOR (1" = 6"), SOIL SANDY, WITH GRAVEL
-2.0 2.5 -3.0 -3.5	X		REDDISH SANDY TAILINGS WITH GRAVEL
-4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0	X		CREAM COLORED SANDY TAILINGS WITH GRAVEL AND ROCK (2" TO 12"). PYRITE MATERIAL MIXED IN THE ZONE. NOTE: THIS LAYER WAS COLAPSING AND UNDER CUTTING WHEN EXCAVATED
-7.5 -8.0 -8.5 -9.0 -9.5 -10.0 -10.5 -11.0 -11.5 -12.0 -12.5 -13.0 -13.5 -14.0			

TD = 7.3' NOTES: NO WATER, PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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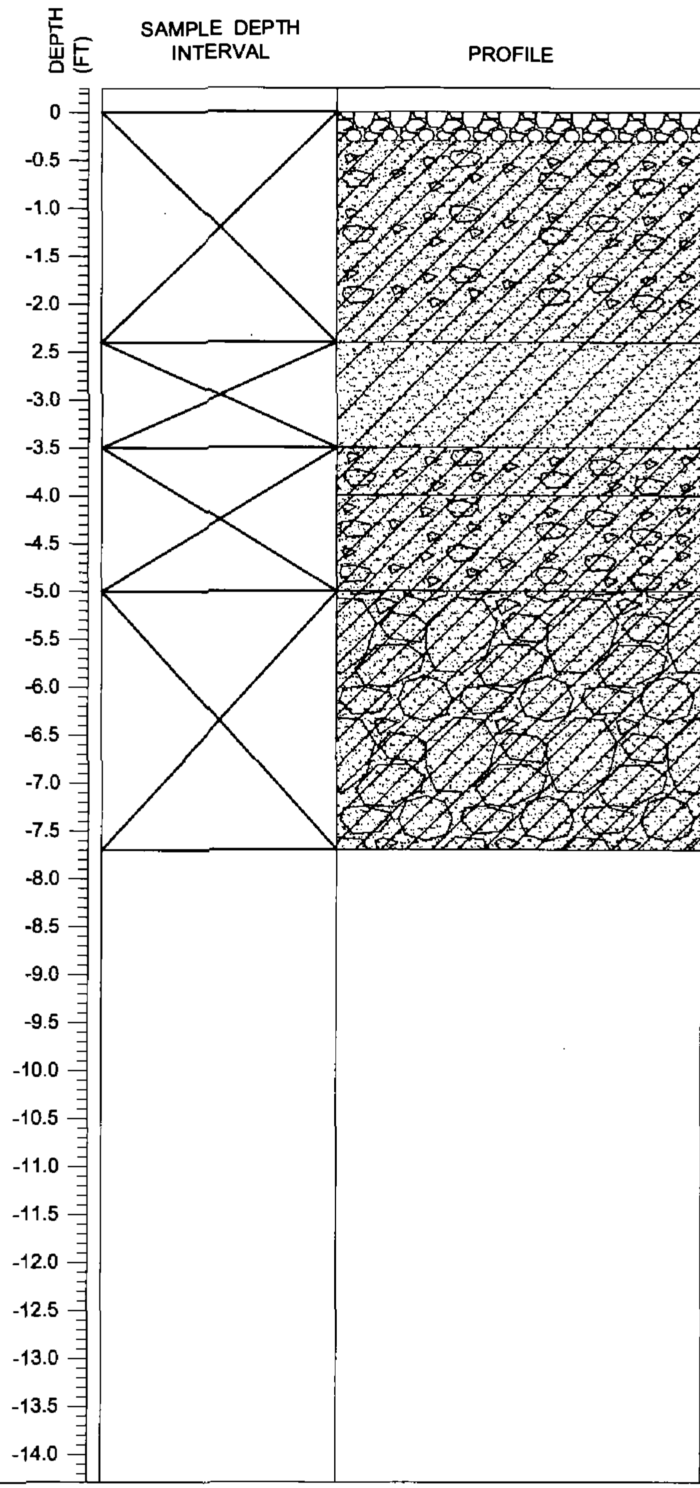
TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-7	COORDINATES OR LOCATION:	LAT: 37.7040 LON: -108.0304
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08



DESCRIPTION

TOP SURFACE GRAVEL
BROWN SOIL - SILTY SAND WITH GRAVEL

BROWN SOIL / TAILINGS, SANDY SOIL WITH SOME SILT MIXED WITH RED TAILINGS (CALCINE)

TAILINGS, LIGHT BROWN TO CREAM IN COLOR, RED OXIDATION STAIN ON ROCK

BROWN SOIL, SILTY SAND WITH GRAVEL

LARGE ROCK ENCOUNTERED (12" - 18") WITH BROWN SOIL, SILTY SAND WITH GRAVEL, CONTAINS MINOR AMOUNT OF TAILINGS

TD = 7.7' NOTES: NO WATER ENCOUNTERED, PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
ENGINEERING COMPANY, INC.

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-8	COORDINATES OR LOCATION: LAT: 37.7044 LON: -108.0299
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/14/08 DATE COMPLETED: 10/14/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -2.0	X		BROWN SILTY SAND WITH GRAVEL AND COBBLES, MOIST APPROX 5% ROCK, MINOR LENSES OF CALCINE TAILINGS
-2.0 to 2.5	X		GRAY/WHITE SANDY GRAVEL, SEVERAL BOULDERS (>= 12" DIAMETER AT THIS LAYER) 60% ROCK
2.5 to -6.0	X		BROWN SANDY SILT WITH GRAVEL AND COBBLES, MOIST, APPROX 5% ROCK

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.6, -12.0, -12.5, -13.0, -13.5, -14.0

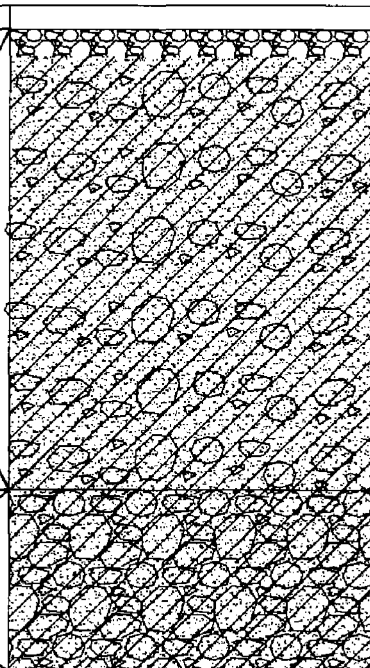
TD = 6.0' NOTES: TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
ENGINEERING COMPANY, INC

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-9	COORDINATES OR LOCATION: LAT: 37.7029 LON: -108.0300
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 6.7' (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08



DEPTH (FT)	SAMPLE DEPTH INTERVAL	DESCRIPTION
0 to -4.8	X	GRAVEL ON SURFACE - BROWN SOIL, SILTY SAND WITH GRAVEL AND ROCK (2" TO 14")
-4.8 to -6.7	X	BROWN SOIL WITH REDDISH TAILINGS, SILTY SAND WITH GRAVEL AND ROCK (2" TO 16"), MIXED WITH TAILINGS, INTERSPERSED CLUMPS OF TAILINGS

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

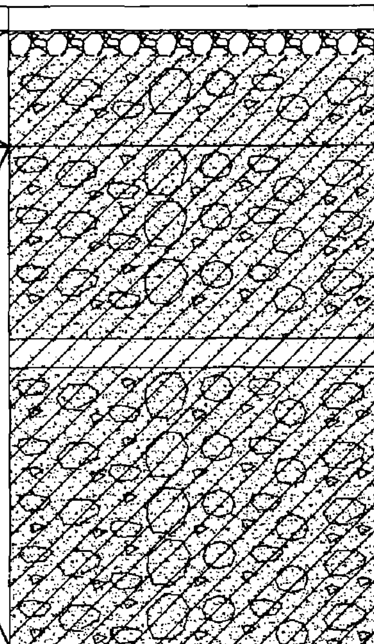
TD = 6.7' NOTES: TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF INTERVAL

ANDERSON ENGINEERING COMPANY, INC.

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-10	COORDINATES OR LOCATION: LAT: 37.7025 LON: -108.0305
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 6.4' (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -1.2	X		GRAVEL ON SURFACE, BROWN SILTY SAND WITH GRAVEL, SOME SMALL ROCK.
-1.2 to -3.2	X		BROWN SILTY SAND WITH GRAVEL AND ROCK (2" TO 12")
-3.2 to -3.5	X		SOIL LAYER - BROWN SILTY SAND, NO GRAVEL
-3.5 to -6.4	X		BROWN SILTY SAND WITH GRAVEL AND ROCK (2" - 12")

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD ≈ 8.4' NOTES: PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
ENGINEERING COMPANY, INC.

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-11	COORDINATES OR LOCATION:	LAT: 37.7018 LON: -108.0302
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 4.2' GWL DEPTH:	(ENCOUNTERED) (STATIC)

DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -0.5	X		LIGHT BROWN SANDY SILT SOIL WITH ¾" GRAVEL
-0.5 to -1.3			LIGHT BROWN SANDY SILT SOIL WITH SOME GRAVEL
-1.3 to -2.5	X		BROWN SILTY SAND AND GRAVEL, SOME ROCK (2" - 8") INTERMIXED TAILS (CREAM AND RED) VERY MOIST
-2.5 to -3.0	X		LAYER OF TAILINGS
-3.0 to -5.0			BROWN CLAY SAND SILT WITH GRAVEL AND ROCK (2" TO 12") INTERMIXED TAILS (LIGHT BROWN / CREAM TO RED)

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.6, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 5.0' NOTES: PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
ENGINEERING COMPANY, INC.

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-12		COORDINATES OR LOCATION: LAT: 37.7013 LON: -108.0304
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:		GWL DEPTH: 3.4' (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -1.0	X		BROWN IN COLOR - SOIL SILTY SAND WITH GRAVEL
-1.0 to -2.0	X		BROWN SOIL - SILTY SAND WITH GRAVEL AND ROCK (2" - 8")
-2.0 to -3.0	X		BROWN SOIL, SANDY SILT WITH GRAVEL AND ROCK, SOIL WET
-3.0 to -4.0	X		BROWN SOIL, SILTY SAND WITH SOME CLAY, GRAVEL AND ROCK, SOIL SATURATED

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 4.0' NOTES: PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
ENGINEERING COMPANY, INC.

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-13	COORDINATES OR LOCATION: LAT: 37.7065 LON: -108.0306
LOGGED BY: KC CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 0' NO WATER (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/14/08 DATE COMPLETED: 10/14/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0	X (0 to -0.5)		GRAVEL SURFACE
0 to -0.5			GRAY SANDY SILT AND GRAVEL, STIFF
-0.5 to 2.5	X (-0.5 to 2.5)		BROWN SILTY SAND AND GRAVEL
2.5 to -3.0	X (2.5 to -3.0)		GRAY SANDY SILT AND GRAVEL, STIFF
-3.0 to -8.0	X (-3.0 to -8.0)		RED CALCINE TAILINGS

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 8.0'

NOTES: TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-14	COORDINATES OR LOCATION: LAT: 37.7069 LON: -108.0312
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0			GROUND BASE COURSE
-0.5 to -8.0	X		RED TO DARK RED TAILINGS (CALCINE) MIXED WITH STAINED ROCK AND TAILINGS (CREAM COLORED), ROCK MIXED IN TAILINGS (2" - 14") APPROX 10% ROCK, SANDY TO SILTY SAND, MOIST

Depth scale (ft): 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 8.0' NOTES: NO WATER, BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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ENGINEERING COMPANY, INC.

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-15	COORDINATES OR LOCATION:	LAT: 37.7054 LON: -108.0292
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)

DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0	X		LIGHT BROWN SOIL, SILTY CLAY WITH SOME SAND, LARGE ROCK (2" - 32") APPROX 35 - 40% ROCK
-0.5			
-1.0			
-1.5			
-2.0			
2.5			
-3.0			
-3.5			
-4.0			
-4.5			
-5.0			
-5.5			
-6.0			
-6.5			LARGE ROCK DIFFICULT TO DIG
-7.0			
-7.5			
-8.0			
-8.5			
-9.0			
-9.5			
-10.0			
-10.5			
-11.0			
-11.5			
-12.0			
-12.5			
-13.0			
-13.5			
-14.0			

TD = 6.2' NOTES: TP 15 AND 16 SIMILAR SOIL PROFILES; TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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TEST PIT LOG			PAGE 1 OF 1
SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-16	COORDINATES OR LOCATION:	LAT: 37.7064 LON: -108.0294
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -5.4	X		GRAVEL ON SURFACE, LIGHT BROWN SOIL, SILTY CLAY WITH SOME SAND, LARGE ROCK (2" TO ~48") APPROX 30 - 35% ROCK
-5.4			LARGE ROCK, VERY DIFFICULT EXCAVATION

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 5.4'

NOTES: TP-16 AND 15 SIMILAR SOIL PROFILES; TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
ENGINEERING COMPANY, INC

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-17	COORDINATES OR LOCATION:	LAT: 37.7074 LON: -108.0294
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to 2.5 (approx. -2.7)	X		GRAVEL ON SURFACE, BROWN SANDY SILT WITH SOME CLAY AND GRAVEL ROCK (2" TO 14"), ROCK CONTENT 25%
-2.7 to -4.0	X		VERY DARK BROWN SILTY CLAY WITH ORGANIC MATERIAL, LITTLE TO NO ROCK, SOIL MOIST
-4.0 to -6.4	X		BROWN SILTY CLAY WITH SOME LARGE ROCK (6" - 14") APPROX 5% SOIL MOIST

Depth scale (FT): 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = NOTES: TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-18	COORDINATES OR LOCATION: LAT: 37.7074 LON: -108.0299
LOGGED BY: KC CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/14/08 DATE COMPLETED: 10/14/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -7.0	X		BROWN CLAY SILT WITH GRAVEL AND COBBLES (3" - >12") APPROX 10% ROCK, MOIST

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 7.0' NOTES: TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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TEST PIT LOG				PAGE 1 OF 1
SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-19		COORDINATES OR LOCATION:	LAT: 37.7069 LON: -108.0298
LOGGED BY: KC CHECKED BY: SDA	SURFACE ELEVATION:		GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A		DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -4.4	X		BROWN CLAYEY SILT WITH GRAVEL AND ROCK (2" - 12"), MOIST, 25-30% ROCK
-4.4			CONCRETE FOUNDATION

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 4.4' NOTES: TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON

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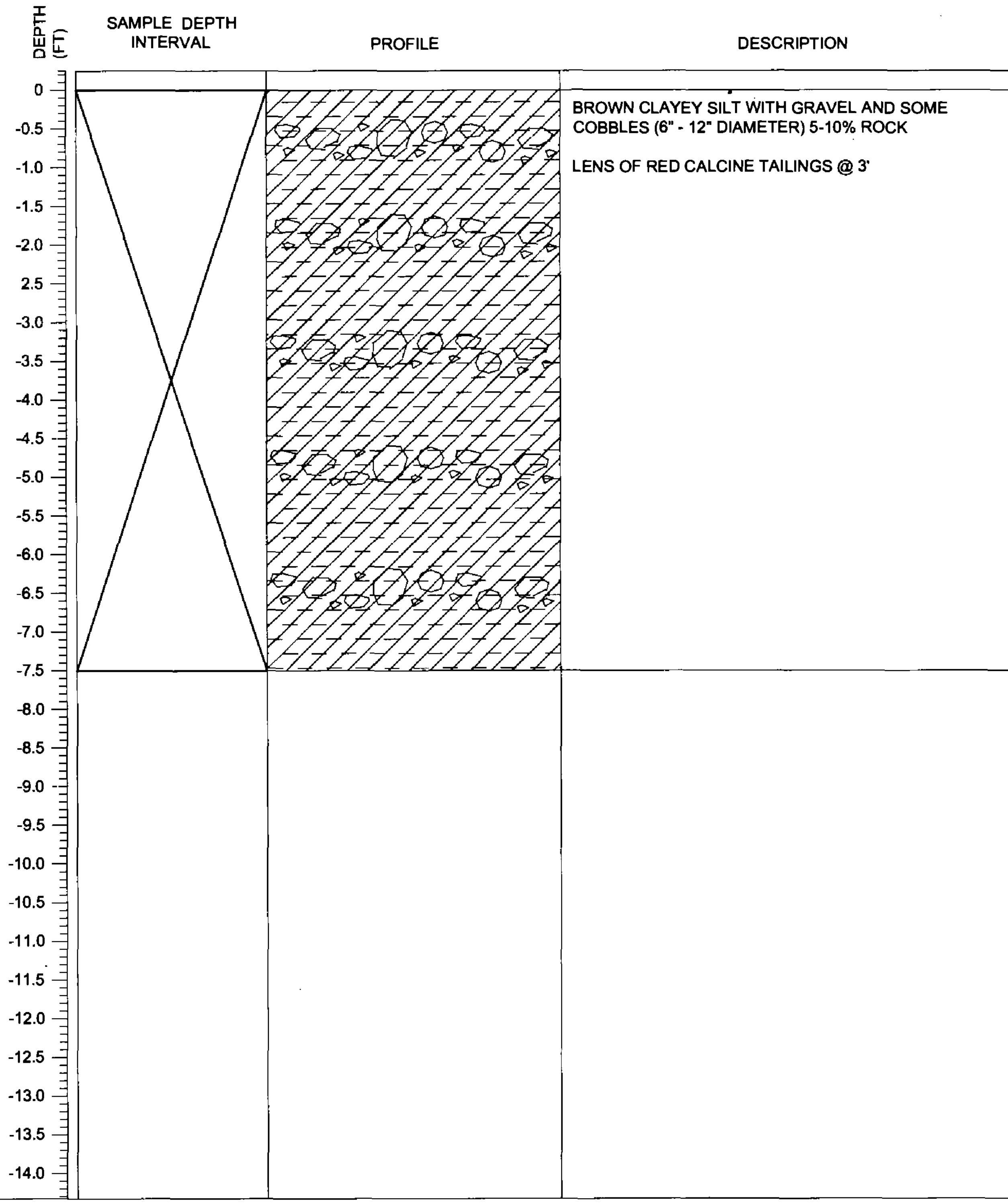
TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-20	COORDINATES OR LOCATION: LAT: 37.7064 LON: -108.0298
LOGGED BY: KC CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/14/08 DATE COMPLETED: 10/14/08



TD = 7.5' NOTES: PIECE OF CONCRETE FOUNDATION WITH END OF PIT AT 2' DEEP, METAL DEBRIS FOUND IN ZONE CONTAINING THE CALCINE TAILINGS. TEST PIT BACKFILLED AND COMPACTED. X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-21		COORDINATES OR LOCATION:	LAT: 37.7070 LON: -108.0302
LOGGED BY: KC CHECKED BY: SDA	SURFACE ELEVATION:		GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08	

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -2.0	X		BROWN SILTY SAND AND GRAVEL
-2.0 to -3.0	X		WHITE AND YELLOW CRUSHED ROCK, MINE WASTE (3" - 6" DIAMETER) ROCK, 60% ROCK
-3.0 to -7.0	X		BROWN SILTY SAND WITH GRAVEL AND COBBLES 10-15% ROCK
-7.0			TD

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 7.0' NOTES: TEST PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-22	COORDINATES OR LOCATION: LAT: 37.7075 LON: -108.0305
LOGGED BY: KC/CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -1.0	X		CRUSHED STONE AND SOLIDIFIED RED SANDY TAILINGS - CALCINE
-1.0 to -2.0	X		ORANGE SILTY SAND WITH GRAVEL AND COBBLES - MINE WASTE
-2.0 to -5.0	X		BROWN SILTY SAND WITH COBBLES
-5.0			TD

TD = 5.0' NOTES: STEEL PIPE IN TRENCH RUNNING N/S AT 1.2' DEEP. PIPE 9" DIAMETER. TEST PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
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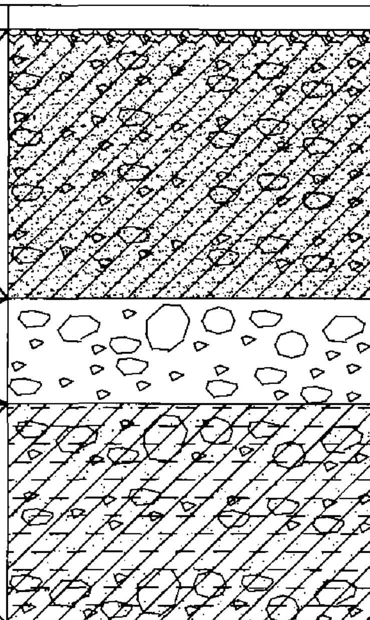
TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-23	COORDINATES OR LOCATION:	LAT: 37.7079 LON: -108.0312
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08



DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -2.8	X		GRAVEL ON SURFACE, DARK BROWN SILTY SAND WITH GRAVEL
-2.8 to -3.9	X		RED TAILINGS (CALCINE) WITH ROCK (2" - 8") APPROX 10% ROCK
-3.9 to -6.2	X		BROWN SOIL, CLAY SILT WITH MINOR SAND, MIXED WITH TAILINGS (CREAM COLORED TAILS). CONTAINS APPROX 15-20% GRAVEL AND ROCK (2" - 12")

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 6.2' NOTES: NO WATER. BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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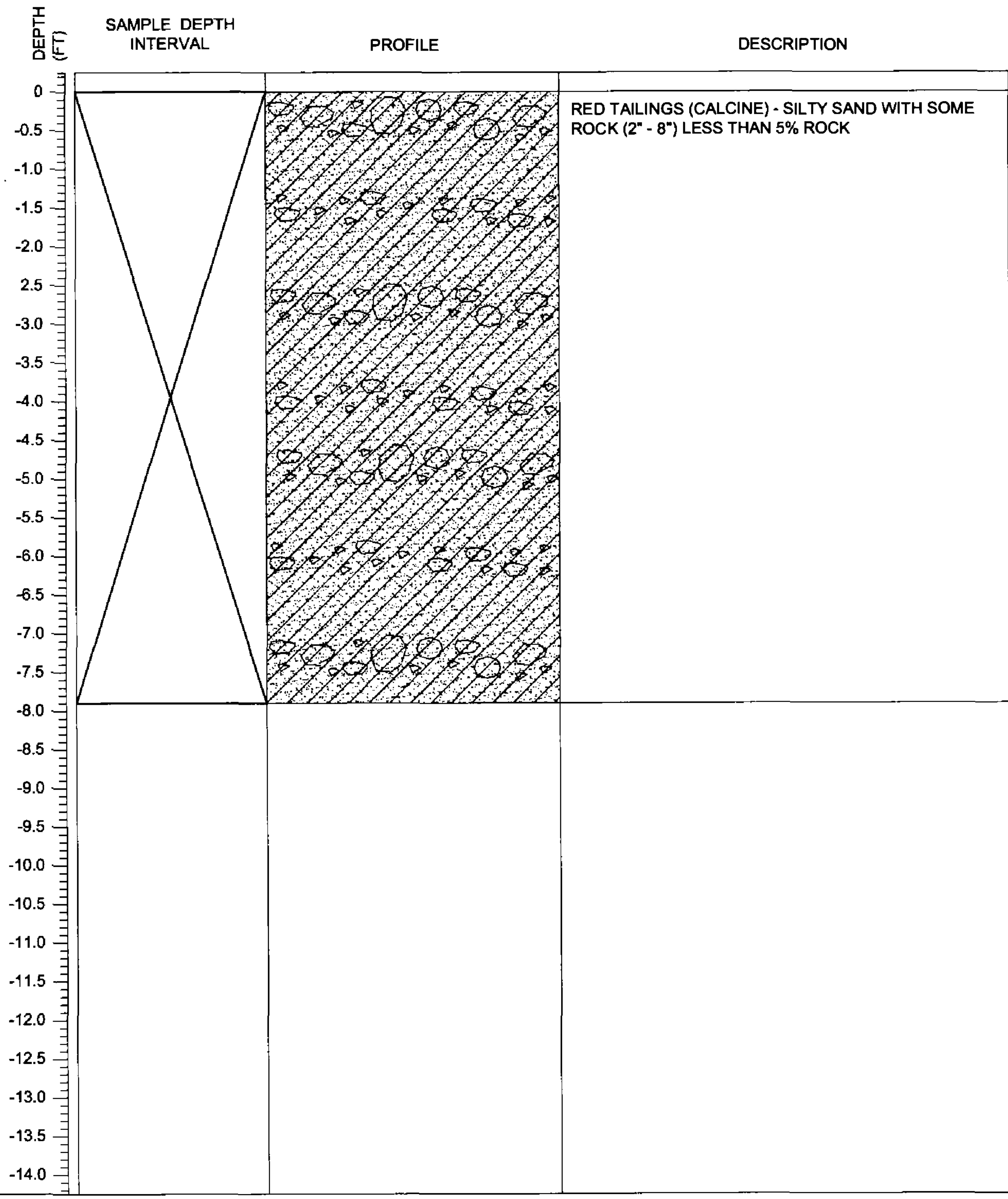
TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-24	COORDINATES OR LOCATION: LAT: 37.7082 LON: -108.0317
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08



TD = 7.9' NOTES: BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
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SEH 2004

TP-2004A

10:00 AM EXCAVATE TP-2004A
0' - 10.5' CAT 436B RUBB TIRE BACKHOE
COLLUVIUM, CLAYEY SAND AND
GRAVEL, DARK REDDISH GRAY
(3/1), BOULDERS TO 2.0',
MOIST, MODERATELY DENSE
BOULDERS AND COBBLES
SUBROUNDED TO ANGULAR,
ESTIMATE 30% > 2"

TP-2004B

TP-2004 B
0 - 7.0' COLLUVIUM
. CLAYEY SAND AND GRAVEL
BROWN (4/3), MOIST, MOD
DENSE, LOW PLASTISITY
FINES, BOULDERS TO 1.0',
COBBLES AND BOULDERS
ANGULAR, TO SUBANGULAR
ESTIMATE 20% > 2"

TP-2004C

TP-2004 C
0 - 5.0' COLLUVIUM
CLAYEY SAND AND GRAVEL
DARK BROWN (3/2), SLIGHTLY
MOIST, FINES LOW TO MOD
PLASTICITY, BOULDERS TO 3.0'
ESTIMATE 15% > 2". COBBLES
ANGULAR TO SUBANGULAR

TP-2004 D
0.0-1.5', TOPSOIL
1.5-6.0' COLLUVIUM
SILTY GRAVELLY SAND,
DARK REDDISH BROWN (3/4),
SLIGHTLY MOIST, LOOSE,
BOULDERS TO 1.0', SUBROUNDED
TO SUB ANGULAR. ESTIMATE
5-10% > 2".

TP-2004D

TP-2004 E
N. OF POND 18 IN CALCINE
TAILINGS
0'-9.0' Calcine Tailings
9.0-12.0' RIVER COBBLES
WATER @ 8.0'

TP-2004E

TP-2004 F
EAST OF POND 18
0-0.5' FILL
0.5-12.0' CALCINE TAILINGS

TP-2004F

TP-2004 G
EAST OF POND 18
0-0.5 FILL
0.5-12.0' Calcine tailings

TP-2004G

TP-2004 H

POND 16/17

0-4.0' FILL

4.0'-12.0' Calcine tailing

GW@ 11.0'

TP-2004 H

TP-2004 I

POND 16-17

0-12.0' Calcine Tailings

~~GW~~ GW@ 12.0'

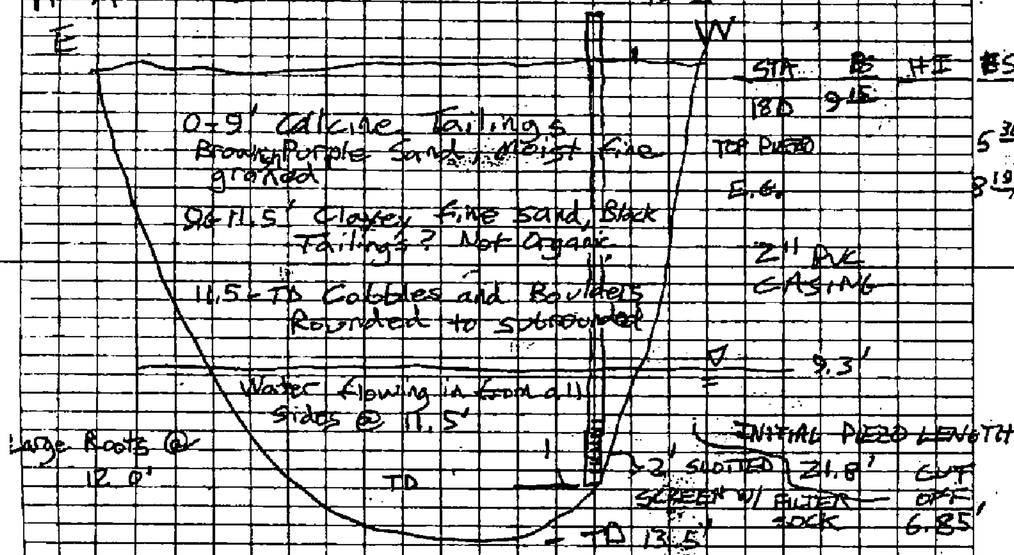
3 SAMPLES EACH PIT

TP-2004I

SEH 2001

TP-A

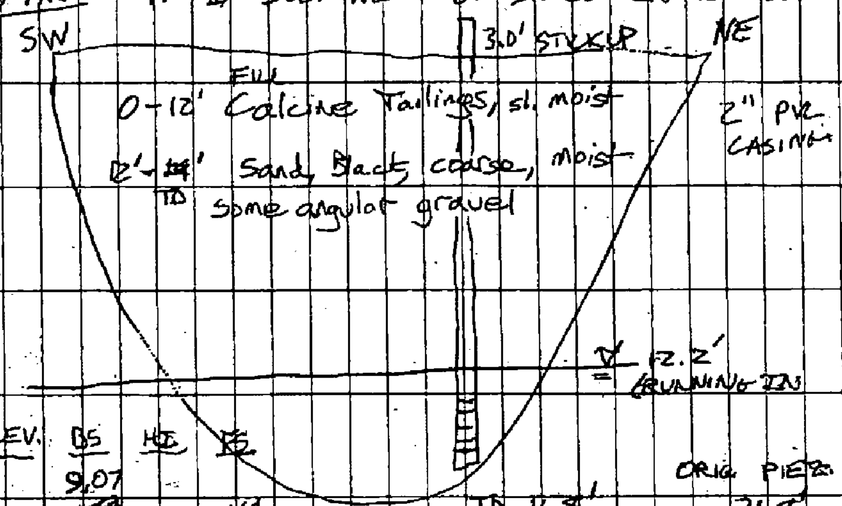
2:33 PM
TP-A ~13 Paces N-NE of Stake 18 D



STA	BS	HI	FS
18D	9.15		
TOP PIEZO			5.36
E.G.			8.19

TP-B

3:40 PM TP-B JUST WEST OF SW CORNER TEST CELL #9

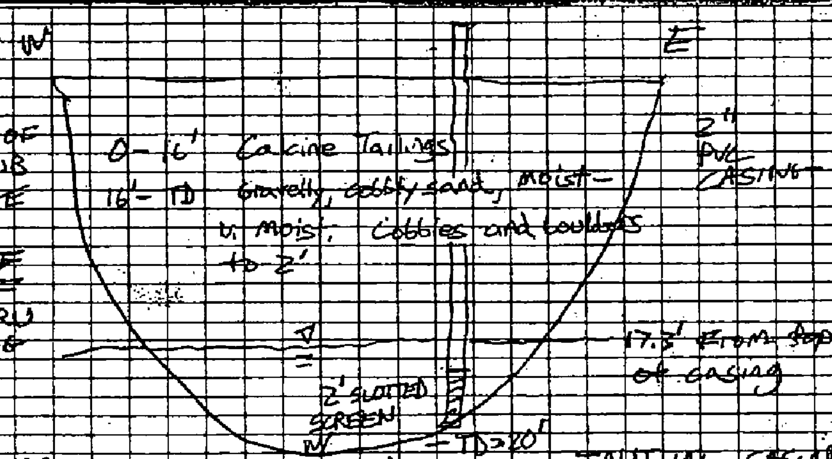


STA	ELEV.	BS	HI	FS
18-J		9.07		
TOP CASING		~~4.64~~	4.64	
EX. GND				

ORIG. PIEZ. LENGTH 21.8'
CUT OFF 1.95'

TP-C

4:10 PM
TP-C
54' YARDS DUE EAST OF 18-G HUB
NEAR EDGE OF ROAD
~~5 O OF~~
~20' S. OF LINE THRU 18-A, 18-G



STA	~~ELEV~~	BS	HI	FS
18-G		3.57		
TOP CASING			2.52	
EX. GND			5.90	

INITIAL CASING LENGTH 28.3'
CUT OFF 5.13'

ANDERSON Engineering Company, Inc. 975 West 2100 South, Suite 100 Salt Lake City, Utah 84119 BUS (801)972-6222 FAX (801)972-6235	ARCO RICO RECLAMATION BORROW MATERIAL	BORING NO. APB-1 SHEET 1 OF 1 DATE STARTED: 10 APR 96 DATE COMPLETE: 10 APR. 96 TOTAL DEPTH: 3.0. SURFACE ELEV: 8885
SAMPLING METHOD: BACKHOE PIT LOGGED BY: Joel MARTINEAU		* Y: N 26680 E. 20135

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
		0			SURFACE HAS ROCKS EXPOSED
APB-1				SC-CL OH -GW	0-0.7 Root ZONE Soil GRAYISH BROWN SANDY-clay to clay w/ ORGANIC MATERIAL AND Minor GRAVEL TO 1CM SIZE. Some Large Rock Sizes, scattered.
	0-3'	1			0.7-3.0 FT Brown Soil w/ Isolated Sub-rounded rock Texture SC-CL. EST 5% Rock >3". Rock Fragments To 4 CM, subangular.
		2			
		3			

ANDERSON Engineering Company, Inc.
975 West 2100 South, Suite 100
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FAX (801) 972-6255

ARCO
RICO RECLAMATION
BORROW MATERIAL

BORING NO. APB-2

SHEET 1 OF 1

DATE STARTED: 10 APR 1996

DATE COMPLETE: 10 APR 1996

TOTAL DEPTH: 3.0'

SURFACE ELEV: 8853

X N 26710 Y E 19940

SAMPLING METHOD: BACKHOE

LOGGED BY: J. MARTINEAU

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
APB-2	0-3'	0		SM-CL + GW	0-1.0' Root ZONE No NOTICABLE ORGANICS Color Reddish-BROWN TO Yellow-BROWN. (Limonitic + Hematitic) FINES SANDY SILT AND CLAY Rocks Mostly Sub-angular
		1		SM-CL + GW	1.0' – 3.0' SIMILAR TO ABOVE LARGER ROCK INCREASING Percentage Largest size 1.5 × 1.2 × 1.7 Two others OVER 1' Screen SIZE
		2			
		3			

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Salt Lake City, Utah 84119
BUS (801)972-6222
FAX (801)972-8235

SAMPLING METHOD: Backhoe

LOGGED BY: J. MARTINEAU

ARCO

RICO RECLAMATION

BORROW MATERIAL

BORING NO. APB-3
SHEET 1 OF 1
DATE STARTED: 10 APR 96
DATE COMPLETE: 10 APR 96
TOTAL DEPTH: 3.0
SURFACE ELEV: 8836
N 26400 E 20000

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
		0			
APB-3				GW-SC-CL	NO NOTICABLE ORGANIC HORIZON
		1			BROWN Soil-Rock Mixture Subangular Rock - consistent gradation from Top to Bottom. (GROUND FROZEN TO 2.5 Ft)
	0-3'				
		2			
					Bottom 3" Water
		3			

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ARCO

RICO RECLAMATION

BORROW MATERIAL

BORING NO.	PPB-4
SHEET 1 OF 1	
DATE STARTED:	10 APR 96
DATE COMPLETE:	10 APR 96
TOTAL DEPTH:	3.0 ft
SURFACE ELEV:	8828
E 19870	N 26475

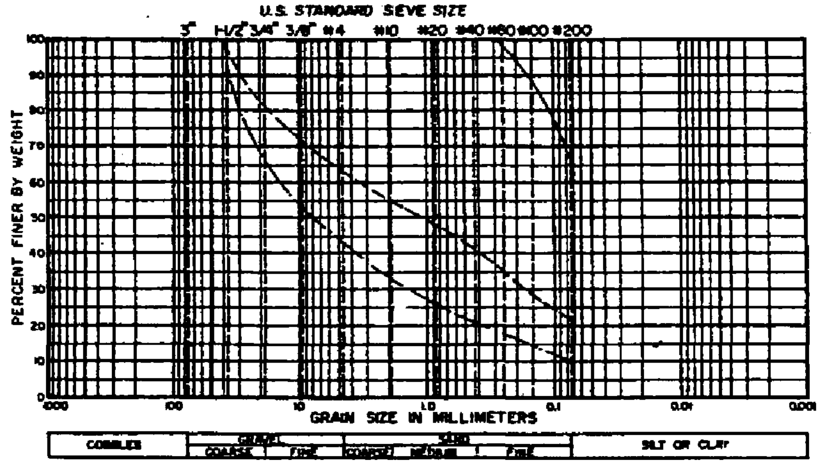
SAMPLING METHOD: BACKHOE
VISUAL ONLY

LOGGED BY: J MARTINEAU

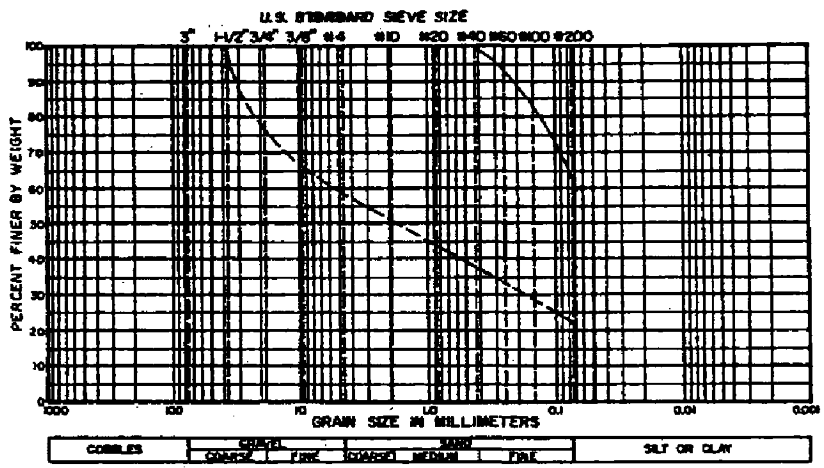
SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USO	DESCRIPTION
NONE Taken VISUAL ONLY	N/A	0 – 3		GW-GP	water level - sits in River Gravels mostly sand & gravel. No soil Horizons Fines About 45-50% 3-12" Rock 45% >12" 3-5% This Material consists Mostly of Rounded Rock & River Gravel; SANDY FINES

Geotechnical Data

- Dames and Moore, 1981

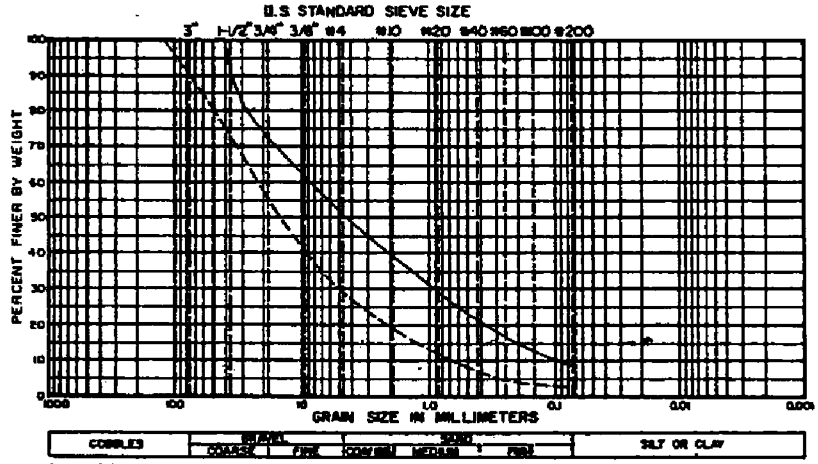


LOCATION	DEPTH	CLASSIFICATION	KEY
~~B-9~~	~~19.5 Feet~~	~~[illegible]~~	———
B-2	9.8 Feet	Yellow and Brown Fine to Coarse Clayey Sand With Some Gravel (SC)	- - - - -
B-8	9.5 Feet	Brown Sandy Fine Gravel With Clay (GM)	— — ·

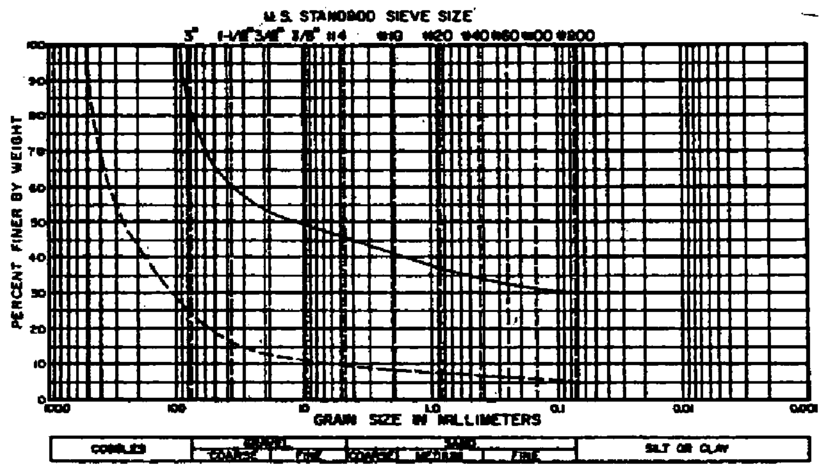


LOCATION	DEPTH	CLASSIFICATION	KEY
~~B-11~~	~~20 Feet~~	~~[illegible]~~	———
B-4	9.5 Feet	Brown Fine to Coarse Clayey Sand With Gravel (SM-SC)	- - - - - ·

GRADATION CURVES



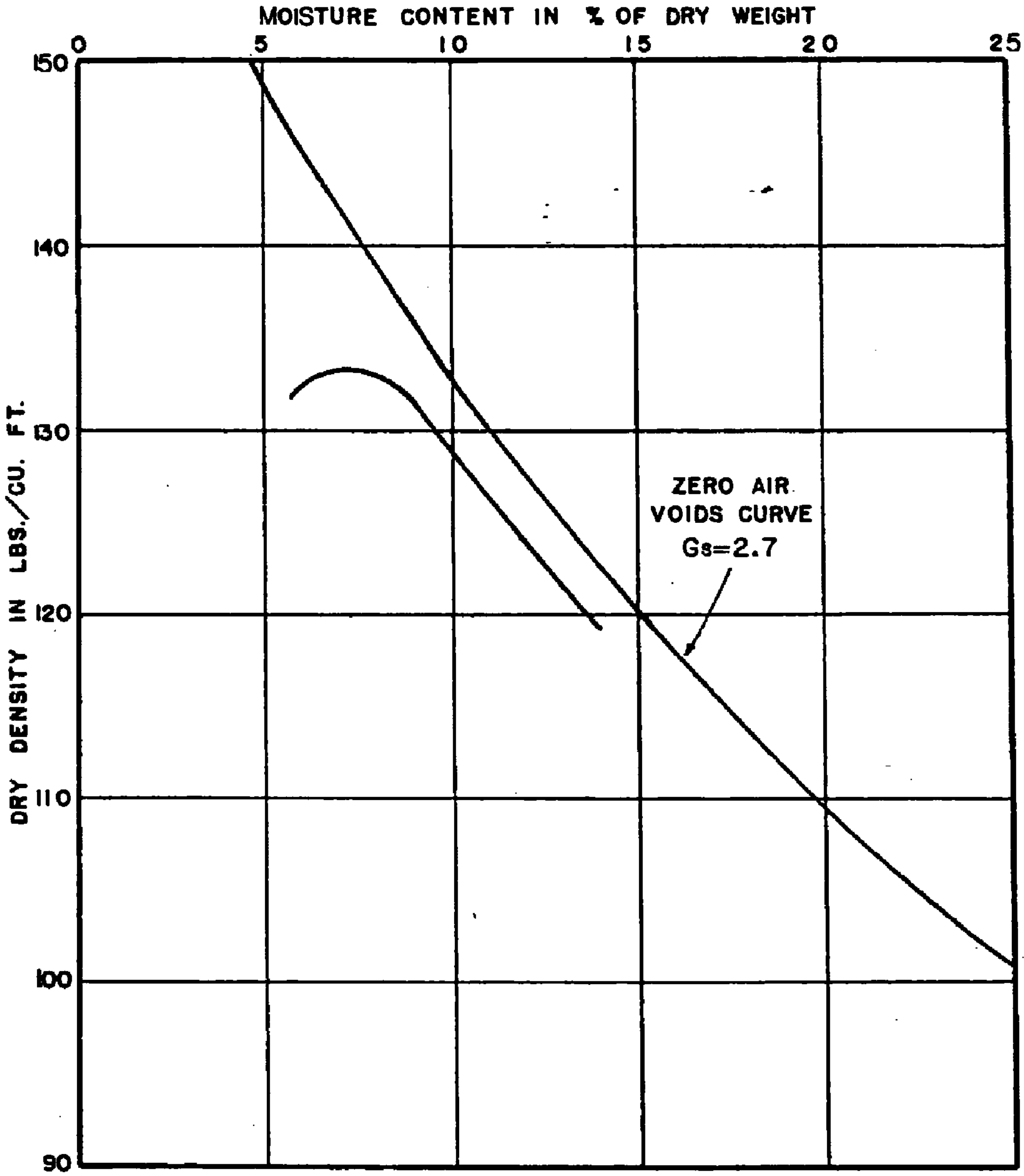
LOCATION	DEPTH	CLASSIFICATION	KEY
St. Louis Adit Borrow	From Cut Above Adit	Brown to Lt. Brown Sandy Fine Gravel and Coarse to Fine to Coarse Sand With Silt (GM-SM)	———
~~Near Boring B-13~~	~~0 to 1 Feet~~	~~[illegible] Coarse [illegible] Sand (GW)~~	– – – –



LOCATION	DEPTH	CLASSIFICATION	KEY
Dolores River	River Bank	Brown Silty Clayey Fine to Coarse Gravel With Cobbles (GM-GC)	———
Dolores River	River Bed	Sandy Gravel with Cobbles (GP)	– – – –

GRADATION CURVES

SAMPLE NO. — DEPTH — ELEVATION —
SOIL Sandy Gravel and Gravelly Sand (GM-SM)
LOCATION Cut Above St. Louis Adit
OPTIMUM MOISTURE CONTENT 7.5 Percent
MAXIMUM DRY DENSITY 133 Pounds Per Cubic Foot
METHOD OF COMPACTION ASTM D-1557 Method C



COMPACTION TEST DATA

DAMES & MOORE

04010-082-1605

SAMPLE NO. – DEPTH – ELEVATION –

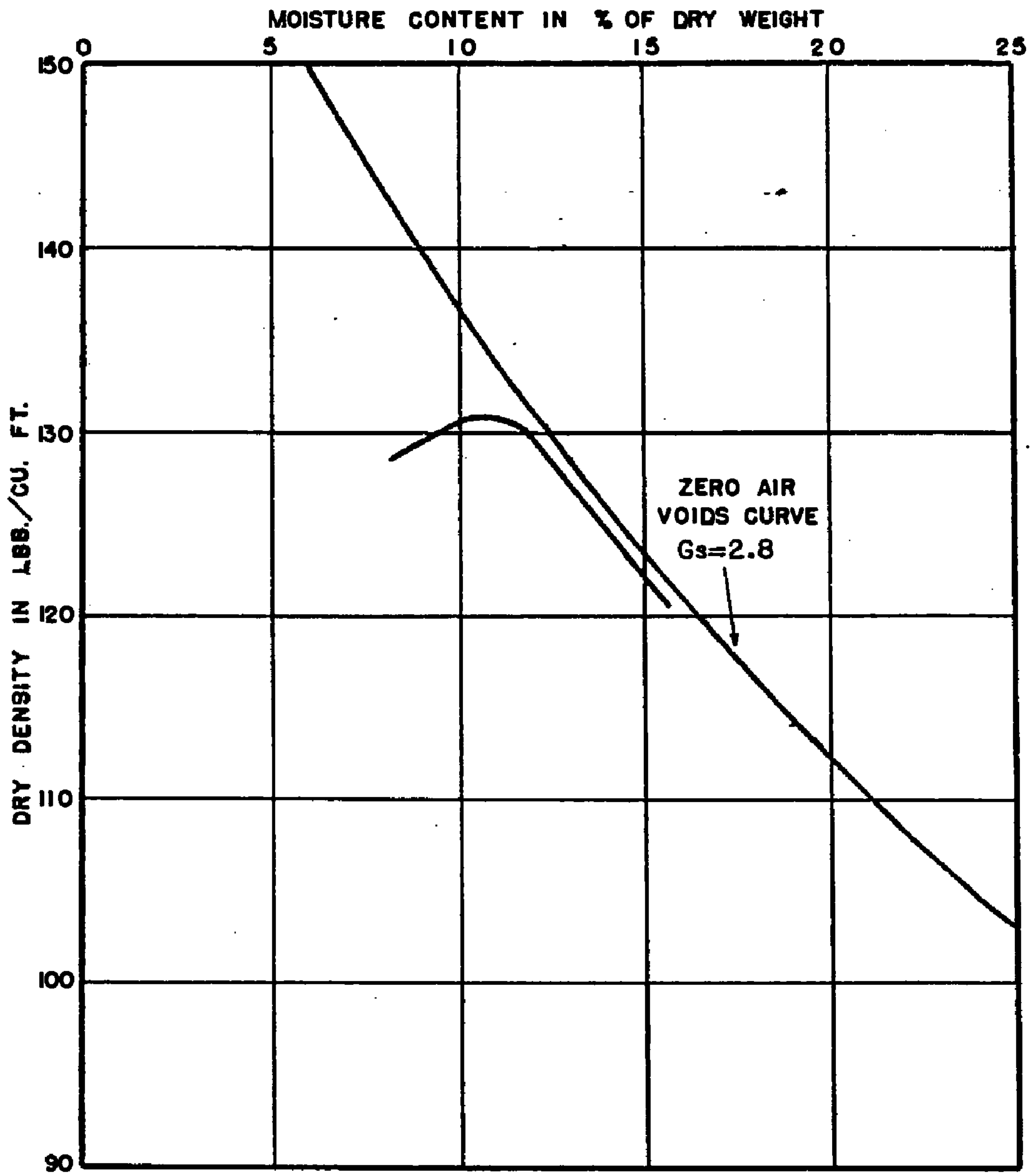
SOIL Brown Silty Clayey Gravel (GM-GC)

LOCATION Dolores River Bank Material

OPTIMUM MOISTURE CONTENT 11 Percent

MAXIMUM DRY DENSITY 131 Pounds Per Cubic Foot

METHOD OF COMPACTION ASTM D-1557 Method C



COMPACTION TEST DATA

DAMES & MOORE

CHECKED BY DATE

BY DATE

BY DATE

04010-082-1605

.1 (REV. 4-57)

Removal Action Work Plan

Rico-Argentine Site
Rico Tunnels Operable Unit OU01
Rico, Colorado

Submitted to:

Environmental Protection Agency, Region 8

Submitted by:

Atlantic Richfield Company

January 14, 2011

Removal Action Work Plan

Rico-Argentine Site, Rico Tunnels Operable Unit OU01
Rico, Colorado

Submitted to:

Environmental Protection Agency, Region 8
1595 Wynkoop Street
Denver, Colorado 80202-1129

Submitted by:

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Prepared by:

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January 14, 2011

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1.0 Objective

The objectives of this Removal Action include:

a. Reduce the risk of releases of hazardous substances from the St. Louis Tunnel and settling ponds into the Dolores River;

b. Collect information necessary for the design and construction of a lime-addition water treatment system for the St. Louis Tunnel discharge and an associated treatment solids repository;

c. Implement response actions that will facilitate the sustained treatment of the St. Louis Tunnel discharge in accordance with a State-issued discharge permit; and

d. Implement response actions that will facilitate the sustained operation and maintenance of a solids repository in accordance with applicable State and local requirements.

2.0 Removal Action Scope

The scope of this removal action includes the following specific actions;

a. Management of precipitation solids in the settling ponds below the St. Louis Tunnel adit discharge, including partial removal of solids from the upper ponds;

b. Construction of an on-Site solids repository in accordance with the siting requirements of the Colorado HMWMD and Dolores County;

c. Investigation of actions that can be feasibly implemented at the collapsed St. Louis Tunnel portal to stabilize the adit opening and consolidate adit flows;

d. Development of a preliminary (30 percent) design for appropriate hydraulic controls at or near the portal opening to manage flows entering the treatment system; and

e. Development of a preliminary (30 percent) design for a new lime-addition and settling ponds water treatment system for the St. Louis Tunnel adit discharge, including upgrades to pond embankments and hydraulic structures.

3.0 Background

3.1 Current Conditions

Location. The Rico-Argentine Site (Site) is defined in the Administrative Order on Consent (AOC) as the complex of tunnels and other facilities at the Rico Argentine Mine, including the Rico Tunnels Operable Unit, OU01, located just north of the Town of Rico, Dolores County, Colorado. The Rico Tunnels Operable Unit, OU01, is defined in the AOC as the portion of the Site consisting of an adit known as the St. Louis Tunnel, and a series of settling ponds located downgradient of the St. Louis Tunnel. The Site is located approximately 0.75 mile north of the northern boundary of the Town of Rico in Dolores County, Colorado (see Figures 3-1 and 3-2). This location is in the SW¼ of Section 24 and the NW¼ and SW¼ of Section 25, T40N, R11W within the USGS Rico 7.5-minute Topographic Quadrangle. Work performed under this Work Plan will generally be limited to the Rico Tunnels Operable UniL

Topography. The RTOU lies at the base of Telescope Mountain (the lower portion of which immediately adjacent to the RTOU is known as CHC Hill) in a relatively flat area (former floodplain) adjacent to the Dolores River (See Figure 3-3). Average elevation is approximately 8,800 feet; maximum relief is on the order of 130 feet: The original Dolores River floodplain has been modified as a result of the historic mining/ore processing activities described in Section 3.2. This includes placement of waste rock and tailings and other grading in the central to northern portion of the RTOU resulting in ground elevated well above the original floodplain surface. At present the active channel and floodplain of the Dolores River are confined to the western portion of the historic floodplain, and are separated from the ponds by contiguous constructed dikes along the east bank of the river.

Climate. Climate is characterized as semi-arid with long, cold snowy winters and short, moderately wet and warm summers. Monthly and annual climatic data has been compiled by the Colorado Climate Center at Colorado State University for Rico station 57017 from 1893 through 1993. The mean annual temperature is 39°F. The warmest months are June, July, and August with monthly mean temperatures of about 55°F. The coldest months are December, January and February with monthly mean temperatures of about 7°F.

Mean annual precipitation in the Rico area is about 27 inches. Most of this precipitation occurs as snowfall in the fall, winter and early spring, averaging about 173 inches per year. Average total monthly precipitation ranges between about 1.4 and 2 inches, with June the driest month and July and August the wettest months with almost 3 inches per month on average. The driest fall month is November with about 2 inches on average.

Facilities/Features. The St. Louis Tunnel (Adit) portal is located at the base of CHC Hill in the north-central portion of the RTOU. Water discharges continuously from the Adit, with flows varying seasonally (highest flows in early spring, lower flows in summer, fall, and winter). A roofed masonry block structure is still present at what is believed to be the original portal location. The first approximately 200 feet of the tunnel behind the portal structure has collapsed due to uncontrolled grading on the slope above as described further in Section 3.2 (see Figure 3-3).

A series of constructed ponds occupy most of the central and southern portions of the RTOU as shown on Figure 3-3. Ponds in the active flow-path are, from upgradient to downgradient: Pond 18, Pond 15, Pond 14, combined Ponds 11-12, and Ponds 9 through 5. Ponds 13 and 10 are not currently in the normal active flow path through the system. Combined Ponds 16-17 have been off-line (i.e., no flow or water storage) for many decades. Ponds 1 through 4 are referenced on historic maps but do not currently receive water discharged from the St. Louis Tunnel.

A soils repository, constructed and operated as part of actions under the Rico Townsite Soils VCUP, occupies approximately 2.6 acres at the base of CHC Hill in the north-central portion of the RTOU (see Figure 3-3). This repository accepts soils with elevated lead concentrations removed from the Town of Rico. The repository has a capacity at full build-out of 40,000 cubic yards.

The abandoned metal building and adjacent steel silo of the original lime addition plant are present near the portal of the St. Louis Tunnel (see Figure 3-3). All lime handling, mixing and feed equipment has been removed from the building and silo.

Utilities. The only active utilities at the RTOU are electric power and telephone lines. Both services are characterized by overhead wires on shared wooden poles. The electrical service provider is San Miguel Power Authority and telephone service is provided by Farmers Telephone Company.

Access. The RTOU is accessed via approximately 0.75 mile of an existing gravel road from Colorado State Highway 145 as shown on Figure 3-3. Highway 145 provides access from Telluride (27 road miles) and Montrose (86 road miles via US Highway 550 and then State Highway 62) to the north and from Cortez (50 road miles) and Durango (92 road miles via US Highway 160 and State Highway 184) to the south (see Figure 3-1).

3.2 Site History

Significant mining began in the Rico area in the early 1900s and flourished around the First World War at the Mountain Spring-Wellington mine in CHC Hill just north of the St. Louis Tunnel. Mining in the immediate area was expanded with the driving of the St. Louis Tunnel by the St. Louis Smelting & Refining Company (a division of National Lead Company, presently N.L. Industries) during 1930-1931 to explore for deep ore horizons beneath CHC Hill. Construction of the existing ponds system is believed to have begun about this same time, followed by subsequent modifications and additions. Available information documents that the upper ponds were present by at least 1956 and the lower ponds by at least 1979.

During 1955 a sulfuric acid plant was constructed and began operation at the RTOU. Roasting of pyrite ore as part of the process to produce sulfuric acid resulted in the generation of fine silt- to sand-size calcine tailings. The calcine tailings were primarily disposed of in Ponds 16 and 17 (not presently in the active flow path of tunnel discharges), as well as in the bottom of Pond 15 (which is in the existing flow path).

Rico Argentine Mining Company ceased most mining operations in 1971 and allowed deeper workings beneath Silver Creek to flood. During 1973-1975, Rico Argentine Mining Company operated a leach heap just northwest of the St. Louis Tunnel, immediately adjacent to the Dolores River. All mining activities by Rico Argentine Mining Company ended in 1976-77, and exploration work ceased in 1978.

In 1980, the Anaconda Company (Anaconda) acquired Rico Argentine Mining Company's surface and mineral properties in the Rico area.

Anaconda conducted exploration drilling from 1980 to 1983, resulting in discovery of a deep molybdenum ore body beneath Silver Creek. Several of these borings were located within the RTOU. Development of this deposit was not deemed economical and, Anaconda never produced ore in Rico. During this same time period, Anaconda performed extensive hazard reduction and environmental clean-up activities in the District, including at the RTOU.

As part of the acquisition of Rico Argentine Mining Company's surface and mineral properties in 1980, a pre-existing NPDES permit (No. CO-0029793) was transferred to Anaconda. In 1983 water from the Blaine Mine on Silver Creek (outfall 002 under the original NPDES permit) was redirected to the St. Louis Tunnel and the Blaine Tunnel (or adit) became zero discharge. In 1984 The Anaconda Company began operation of a new slaked-lime addition plant to treat mine water discharge from the St. Louis Tunnel as it entered the ponds system. Between 1984 and 1995, slaked lime was added to the tunnel discharge to improve water treatment and solids removal.

The acid plant and associated structures at the RTOU were demolished, and the area of the former plant was regraded, capped with a soil cover, and revegetated during 1985-1986. Other miscellaneous grading has apparently occurred at various locations in the northern portion of the RTOU.

Atlantic Richfield Company ("Atlantic Richfield"), a successor to Anaconda, sold its Rico properties to Rico Development Corporation in May 1988. The existing NPDES permit transferred to Rico Development Corporation at that time. Rico Development Corporation then sold/optioned its property holdings and the NPDES permit to others in April 1994. While owned by Rico Development Corporation, it is believed that borrow excavation over the portal area of the St. Louis Tunnel in about 1996 resulted in local collapse of the tunnel roof and walls. Around this time use of the slaked lime system was discontinued and mechanical components were removed (the plant building is still present at the site). The NPDES permit expired in 1999.

In 2001, Atlantic Richfield collected the dispersed surface flows from the tunnel portal collapse area into a common channel, diverted the flow through a Parshall flume, and re-routed it to Pond 18. Atlantic Richfield also cleared and maintained existing hydraulic facilities/structures and constructed new controlled overflows (spillways) in the ponds flow system at various times over the past approximately 10 years. Further improvements to provide for additional normal freeboard and spillway capacity at Pond 18 were implemented in the fall of 2010.

4.0 Summary of Work To Date

A series of investigations and related activities relevant to tasks described in this Work Plan have been completed. These include:

- Site Topographic Mapping and Surveying. Topographic mapping of the Site from aerial photography is available from 1980 (Intrasearch – 5-foot contours; Anaconda Company site datum), 1994 (Olympus - 2-foot contour interval), and 2004 (Aerodata - 2-foot contour interval). Ground surveying of various locations and features has also been conducted at various times, including in association with soil lead VCUP operations at the staging area and soil lead repository site immediately north of the St. Louis Ponds and to support ongoing improvements to the hydraulic functioning and safety of the existing ponds system.
- Surface Water and Groundwater Monitoring. Monitoring of surface water flow and quality at and in the vicinity of the RTOU has occurred at varying locations and frequencies since 1978. A more regular program of surface water sampling and analysis was implemented in 1999, followed by adoption of a formal, regulatory Sampling and Analysis Plan in 2003. A total of 21 sampling events were conducted from 2001 through 2006 by Atlantic Richfield, ranging from a minimum of two (2) to a maximum of eight (8) events per year. The CDPHE conducted groundwater sampling and analysis in 2002 and 2003. Atlantic Richfield conducted groundwater monitoring from 2004 to 2007.
- Geochemical Sampling and Analysis of Pond Bottom Settled Solids. As part of a broader study to characterize and develop recommendations for upgrades to the prior lime addition treatment system, Paser (1996) performed detailed field sampling and field and laboratory geochemical analyses of the settled treatment solids in Ponds 18, 11, 9 and 5.

- **Tunnel Discharge Treatability Studies.** Alternative methods for treating discharge were investigated, including the previously used lime amendment. Lime addition rates were evaluated for their potential to achieve potential water quality discharge standards and solids production rates were characterized.
- **Whole Effluent Toxicity (WET) Testing.** Laboratory studies were conducted to evaluate the potential of treated effluent to meet WET requirements associated with a point-source surface water discharge permit. The primary objective of these studies was to identify the probable sources of toxicity in St. Louis Ponds discharge water to the indicator species (*Ceriodaphnia dubia*).
- **Mixing Zone Evaluation.** Field surveys and flow measurements were utilized to confirm that discharges from the St. Louis Ponds would adequately mix with the receiving stream (Dolores River) low flows within regulatory distances. The methodology and results of the mixing zone evaluation are presented in Atlantic Richfield (2008)[1].
- **Water Quality Assessment.** A Water Quality Assessment (WQA) has been issued by CDPHE[2] (see Attachment 1) and will be the basis for the water quality discharge permit for the water treatment system, including identification of discharge permit effluent limitations. Atlantic Richfield provided input on the preliminary draft, followed by several years of additional watershed sampling, laboratory analysis and data evaluation. The WQA was finalized and issued by CDPHE in November, 2008.
- **Solids Handling, Dewatering and Disposal Studies.** Both existing and lime amended solids were studied in laboratory (vacuum filter, column settling/consolidation), pilot-scale (field dewatering cells; small-scale field solids generation) and full-scale (Pond 18 dewatering and solids removal) tests, in order to identify and evaluate methods for settling, relocating, dewatering and safely storing treatment solids.
- **Site Geologic/Geotechnical and Groundwater Investigations/Exploration.** Geologic, geotechnical and groundwater conditions at the RTOU have been investigated by site geologic reconnaissance and mapping, field exploration (including monitoring wells, exploratory borings and test pits), geotechnical laboratory testing, and groundwater sampling and analyses on a number of occasions from 1981 to 2004. The exploratory locations and interpreted geologic, geotechnical and groundwater conditions derived from these investigations are presented in Attachment 2.
- **Soil Lead Repository Design and Construction.** Studies were completed to identify a feasible location for a repository to contain lead-bearing soils removed from yards/lots in the Town of Rico under the Townsite Soils VCUP. The repository was designed, permitted, and initial construction completed by 2005. Though the future use of this repository is dedicated to soil from the Town of Rico, its design and regulatory requirements are similar to what is anticipated for the repository for water treatment solids disposal to be developed under this Work Plan.

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[1] Atlantic Richfield Company, 2008. Technical Memorandum on Mixing Zone Analysis for the St. Louis Ponds Discharge, Rico, Colorado. July 1.

[2] Colorado Department of Public Health and Environment (CDPHE), 2008. APPENDIX A, Water Quality Assessment, Mainstem of the Dolores River, St. Louis Tunnel Discharge. October 29.

5.0 Task Descriptions

5.1 Task A – Management of Precipitation Solids in the Upper Settling Ponds

Objective

The primary objective for this task is to increase the pond capacity to provide adequate detention time and space for future interim accumulation of settled solids. Partial solids removal will also reduce the risk of releases of hazardous substances in the unlikely event of a breach of the dikes between the ponds and the Dolores River. Solids removal and drying will begin with Pond 18 and proceed sequentially through the other upper ponds, as necessary.

Background

Solids have accumulated in the upper ponds at the RTOU as a result of precipitation and settling of metal complexes by natural processes and by addition of lime to the St. Louis Tunnel discharge from 1984 to 1995. An inventory of existing solids was performed in 2001 by precision sun/eying utilizing a sampling boat outfitted with a survey prism and depth sounding rods. The calculated volumes of solids based on the field surveys were as follows:

- Pond 18 – 20,000 cubic yards (reduced to approximately 50 percent or 10,000 cubic yards during a subsequent in situ dewatering test)
- Pond 15 – 11,000 cubic yards
- Pond 14 – 2,600 cubic yards
- Pond 13 – not inventoried due to unsafe surface access
- Ponds 11 and 12 – 10,600 cubic yards

Based on testing of recovered minimally disturbed core samples, the settled solids were estimated to have a weighted average percent solids density (weight of dry solids/total wet weight) of 12.9 percent and an average specific gravity of 2.42. Assuming these parameters, it is estimated that there are a total of approximately 12.4 million pounds of solids (dry weight) present in the ponds system. Relatively few settled solids were observed below Pond 11 and those ponds were not included in the 2001 inventory.

5.1.1 Subtask A1 – Develop Initial Solids Removal Plan

5.1.1.1 Compile, Review and Evaluate Existing Data

Available data from previous site investigations and laboratory testing of accumulated solids in the upper ponds will be compiled, reviewed for relevance to the planned initial removal, and evaluated to support development of appropriate removal means and methods.

5.1.1.2 Evaluate Removal Alternatives

There is not enough flat ground available to allow all solids in Ponds 18, 15, 14 and 11-12 to be removed and dried at one time. By using the space in the Pond 16/17 area, drying of solids removed from Pond 18 should be completed in 2011. This expectation is due to the prior and ongoing consolidation of solids resulting from removal of surface water from Pond 18 for 10 months in 2001-2002 during a field-scale test of solids removal and again beginning in October 2010 to perform maintenance on the outlet facilities. Solids from other upper ponds will be removed in stages over a one to two year period to complete the initial removal. The dried solids will then be transferred to the solids repository when its construction is completed.

Two previously identified alternatives will be further evaluated to arrive at one or more acceptable procedures to remove and transport solids from the subject ponds. The preferred alternative is use of conventional earthmoving equipment, which will involve the following steps: 1) routing incoming flow around the pond from which solids are to be removed to the next downgradient pond in the flow path; 2) decanting and pumping off surface water from the pond, allowing initial solids consolidation in place; 3) excavation with conventional earthmoving equipment; and 4) truck hauling to a temporary on-site drying facility. If this alternative proves infeasible for solids to be removed from beneath the groundwater table, then a dredging alternative would be further evaluated. This alternative would involve: 1) routing incoming flow around the pond from which solids are to be removed to the next downgradient pond in the flow path; 2) suction dredging from a floating, shallow draft barge with an appropriately designed continuously agitating suction head; and 3) conveyance via pipeline to a temporary on-site combined decant (initial consolidation) and drying facility. If necessary to prove out the feasibility of the dredging alternative, a dredging contractor may be engaged to perform field-scale trial removal at one or more ponds.

5.1.1.3 Drying Facility Siting and Layout

The following key issues and criteria will be addressed in the siting and layout of solids drying facilities:

- An interim drying facility will likely be needed for staging and drying of solids removed from Pond 18 in 2011, while Atlantic Richfield completes the final design, and construction of a permanent drying facility (to be constructed in conjunction with the solids repository) that can be used for subsequent pond removals and long-term (50-year) operational needs;
- Adequate area will be needed to spread treatment solids in a relatively thin lift to promote more rapid enhanced drying (dewatering and consolidation);
- Existing grade should be above seasonal high groundwater, or there should be an ability to raise grade with earth fill; and
- Final elevation and grade of a drainage system should allow gravity discharge from the drying facility to an existing downgradient pond in the treatment system; and

The Pond 16/17 area is expected to be used for the interim drying facility. This location is preferred due to its close proximity to ponds containing most solids, and there is a significant amount of flat ground to use. An assessment will also be made of alternative locations for the interim drying bed and permanent enhanced drying facility. Alternatives will include the existing Pond 13, the flat area immediately north of the treatment ponds system, and the existing dry Ponds 16 and 17 area (see Figure 5-1). The alternatives will be compared and preferred locations selected for both the interim and permanent facility based on technical feasibility, constructability, potential for integrating the Interim and final facilities, and compatibility with other treatment system components and operations. The potential to convert the interim facility to a permanent facility will also be evaluated.

5.1.1.4 Drying Facility Design

Key issues to be addressed during the design of the interim and permanent drying facilities will include:

- Analysis of subgrade conditions, including bearing capacity and potential for total and differential settlement under equipment, system component, and treatment solids loads
- Evaluation of potential for natural downward drainage to groundwater of water expelled from treatment solids during dewatering and consolidation, versus need for a constructed drainage layer over prepared subgrade

The major components of the drying facilities to be designed include:

- Engineered controls (site grading, ditches, berms) to prevent storm water run-on to the site facilities and manage direct precipitation runoff from the site
- Provision for gravity drainage of direct precipitation and possibly high groundwater and/or dewatering discharge from the facility; if Pond 13 is the selected alternative for the enhanced drying facility, a stable permanent breach of the existing Pond 13 embankment will be required
- A sacrificial trafficking layer, if needed, to facilitate placing and spreading treatment solids in the dewatering/consolidation cells
- Cell divider/equipment access berms
- A filter-protected drainage layer, if needed to promote rapid downward drainage (and resultant dewatering and consolidation) of placed treatment solids

Design analyses will include bearing capacity utilizing standard foundation engineering calculations and consolidation/settlement utilizing standard calculations, or if necessary depending on the subgrade conditions, the SIGMA/W software by Geo-Slope International. If necessary based on the design analyses (particulariy in the case that Pond 13 is the selected alternative), the use of reinforcement-grade geotextile and/or geogrid will be considered to provide an adequately stable subgrade for the facility.

Calculations will be performed to evaluate the potential for downward drainage from the placed treatment solids to the underlying alluvial aquifer. These calculations will be made with standard infiltration/seepage equations, flow nets, or utilizing the SEEP/W software by Geo-Slope International. If a constructed drainage layer is required to promote adequate dewatering and consolidation of the treatment solids, hydraulic calculations based on Darcy's equation will be use to size, slope, and select the appropriate gradation for the drainage layer; collection and conveyance piping will be sized and sloped based on standard pipe flow equations. A filter layer will be designed to protect the drainage layer from clogging by movement of the fine-grained treatment solids into the coarse-grained drainage material. The filter compatibility of the drainage layer with the underiying subgrade will also be checked and the drainage material gradation adjusted or a second filter layer designed if necessary. Filter compatibility and design will be based on the current methodologies practiced by the Natural Resources Conservation Service (NRCS), U. S. Bureau of Reclamation (Bureau), and/or U. S. Army Corps of Engineers (COE).

5.1.1.5 Solids Removal Process

Based on the field investigations and related laboratory testing conducted in 2001-2002 and subsequent observations at the RTOU, it is expected that initial solids removal would involve the following sequential steps and methods:

1) Divert inflow Into the pond from which solids are to be removed utilizing an appropriate combination of berming, ditching and piping. (Flow through Pond 18 was diverted in Fall 2010.)
2) Remove the surface water in the pond by siphoning and/or pumping; convey the water removed to the next pond downgradient. (Pond 18 water was pumped down in Fall 2010.)
3) Allow the now exposed solids to dewater in place for as long as possible, with the objective of drying sufficiently to remove with earthmoving equipment. (It is expected that Pond 18 solids will be sufficiently dried for removal with earthmoving equipment in the summer of 2011.)
4) Excavate and haul the dewatered solids to the drying facility using conventional earthmoving equipment (e.g., tracked excavators and/or loaders, dump trucks).
5) If groundwater levels are too high to allow adequate drying/consolidation of all the solids in the pond scheduled to be removed, remove the additional solids utilizing appropriate dredging equipment and methods, and convey the dredged material to the drying facility.

Specific details on the configuration, construction, and use of the interim drying area will be developed in the Solids Removal Plan.

5.1.1.6 Solids Removal Plan Elements

A Solids Removal Plan will be developed based on the available information and the findings of field assessment. The plan will address the following issues, elements and criteria:

- Priority sequence of solids removal (initially assumed as beginning at Pond 18 in 2011 and progressing to downgradient ponds in 2012-2013)
- Estimated average depth and volume of solids removal (measured as in situ saturated volume in the pond)
- Minimum thickness of settled solids to remain in the pond as a low permeability layer in each pond
- Range (minimum and maximum) of anticipated initial removal volume to be accomplished in 2011, and total initial removal volume to be accomplished
- Interim drying area design
- Estimated volume of dewatered (i.e., "dried") material to be removed from the interim on-site drying (or combined decant and drying) facility and placed in a permanent on-site repository in 2012-2013
- Process and schedule for removal of solids in 2011, and subsequent years

The Solids Removal Plan will be submitted as part of a Work Plan amendment for review and approval by the Agencies.

5.1.2 Subtask A2 – Drying Bed Construction and Solids Removal

Removal activities will commence following approval of the Solids Removal Plan. Removal will proceed in the sequence and utilizing approved means and methods as identified in the Solids Removal Plan. Work will include the following primary construction activities: 1) construction of the interim drying facility; and 2) solids removal and transport to the interim drying facility.

The activities of the selected construction contractor will be overseen by Atlantic Richfield on a full-time, on-site basis. Depending on actual conditions encountered during the course of the work, appropriate adjustments in the sequence and/or the means and methods of removal may be identified. Any such adjustments will be presented to the Agencies for timely review and approval, and upon approval, implemented by the construction contractor.

In addition to observing the quality of the work, Atlantic Richfield oversight will also track and record the depth and volume of solids removed from each pond and the location and time of placement in the interim on-site drying (or combined decant and drying) bed facility. Periodic surveys will be made of the solids deposited in the drying bed to document the amount and rate of ongoing consolidation.

An ongoing assessment will also be made of the need for control of dust from the interim drying bed facility. The surface of the solids in the drying bed will be treated either with a light water spray or a suitable dust suppressant as necessary.

5.2 Task B – Construction of a Solids Repository

Objectives

Permanent disposal of settled treatment solids on site is a key objective of the removal action. On-site disposal of treatment solids from the initial removal from existing ponds described in Section 5.1 and during future operation of the water treatment system outside of this AOC provides significant advantages compared to off-site disposal, including:

- Consolidate treatment solids with other existing, related mine wastes at the RTOU.
- Avoid potential public inconvenience, safety issues, and environmental impacts that would or may arise with large-scale, long-term hauling of solids to an off-site facility (especially in the event of accidents or spills).
- Long term management of disposed solids at a controlled location.
- Minimize handling and conveyance time (and associated equipment emissions).
- Minimize cost of permanent disposal of solids.

Another key objective is to provide a capacity for a minimum of fifty years for treatment solids disposal on-site, if possible. It is anticipated that within that period of time other treatment or disposal alternatives and/or inflow loading/reduction technologies may become feasible.

Overview

Task B includes compilation, review and evaluation of existing data, alternatives evaluation, design, and construction of the solids repository. Additionally, siting of potential supplemental solids repositories will be performed. Though several repository alternatives will be considered, it is assumed that the preferred alternative will be the dry-stacked repository as described below. The dry-stacked repository design allows for more efficient use of available land and provides a more stable long-term repository than a wet-conventional design.

5.2.1 Subtask B1 – Repository Design and Plan

5.2.1.1 Compile, Review and Evaluate Existing Data

Available data from previous site investigations and laboratory testing of foundation conditions and potential borrow locations at the RTOU will be compiled, reviewed for relevance to the planned on-site repository, and evaluated to support design of this facility.

5.2.1.2 Repository Siting

Alternative locations for the treatment solids repository will be identified and characterized. Potential site locations identified to date are shown on Figure 5-2. Site characterization will address existing facilities, the presence of historic mining wastes, geology (including groundwater, geologic hazards, subgrade conditions, etc.), hydrology (direct precipitation and storm runoff), and known or potential current or future compatible or conflicting land uses. Site selection will be based on anticipated solids properties (especially dry density), operational efficiencies and cost considerations, and if necessary, land use and/or ownership status at the time a final decision must be made.

5.2.1.3 Supplemental Field Investigations and Laboratory Testing

Field investigations will be conducted to confirm previous data and gather additional data as to key physical properties of the repository foundation and potential on-site borrow materials for construction. The field investigations will include up to three test pits/trenches and two exploratory borings (or cone penetrometer soundings) within and/or in close proximity to the proposed repository footprint, and up to six test pits/trenches in each of up to two potential on-site borrow locations. Borings and test pits will be logged and photographed. The final decision as to the number and location of borings, soundings and test pits will be based on the results of the existing data review and the repository site alternatives evaluation.

Samples will be acquired for geotechnical laboratory testing including: gradation; Atterberg limits (for plastic soils); and laboratory moisture/density relationship. If placement of a significant volume of predominantly fine-grained, plastic soils is anticipated based on the foundation conditions, available on-site borrow materials encountered and conceptual repository design, then shear strength (e.g., consolidated-undrained triaxial testing with pore pressure measurement) and consolidation testing may be performed. In addition, triaxial shear strength and associated consolidation testing will be performed on existing precipitation solids samples generated by lime addition to St. Louis Tunnel discharge in 2006.

5.2.1.4 Repository Design

The design of the on-site repository will address the following issues and criteria:

- Provide capacity for 50-years, if possible, of solids disposal from rehabilitation of the settling ponds and future operation of the treatment system (i.e., 50-year repository design life)

- Provide run-on-runoff erosion protection to accommodate active operations during the pre-closure period and long-term protection during the post-closure period
- Minimize infiltration and resultant leachate generation
- Minimize release of untreated leachate
- Achieve adequate factors of safety (FS) against slope failure under appropriate loading conditions

As discussed further under Slope Stability below, the ultimate dry density (and associated shear strength) of the treatment solids to be placed in the repository will govern the type of repository (i.e., wet-conventional versus dry-stacked) and if dry-stacked, the stable slope inclination. Based on studies to date, it is assumed that the design will move forward based on a dry-stacked repository concept.

Design evaluations/analyses and design features to address these issues and achieve these criteria are described in the following paragraphs.

Capacity Determination. The required capacity of the repository will be established by conservatively estimating the volume of solids to be removed from the upper ponds and the average annual production of treatment solids, and the degree of dewatering and consolidation anticipated prior to placement of the solids in the repository. Initial design will be based on the results of prior field and laboratory testing and proposed additional laboratory testing of representative treatment solids as described above under Supplemental Field Investigations and Laboratory Testing. As discussed further under Solids Repository Permitting below, the required capacity of the repository will be further evaluated during the first years of full-scale operation by monitoring of the effectiveness of the proposed means and methods of dewatering and enhanced drying of removed solids.

Given the required design capacity, a final location and preliminary plan layout of the full-build out of the repository will be prepared as part of the design documentation (see below). The layout will then be refined in coordination with the infiltration/leachate control and slope stability design described below.

Run-on-Runoff and Infiltration Control. The Hydrological Evaluation of Landfill Performance (HELP) model will be utilized to evaluate the potential infiltration of direct precipitation (snowmelt and rainfall) and resultant leachate generation within the repository. Infiltration will be minimized to the extent practical by a combination of runon control utilizing ditches/berms, appropriate sloping of the repository top and side slopes, and placement of interim cover material during operation and permanent cover material upon final filling. Interception ditches/berms will be designed to safely convey runon from the 25-year, 24-hour storm during the pre-closure period and from the 100-year, 24-hour storm during the post-closure period of the repository, as approved by CDPHE for the existing on-site Soil Lead Repository. Interim (pre-closure) cover material will be designed primarily to control dust generation from, and erosion of, the placed treatment solids, and secondarily to minimize infiltration to the extent practical consistent with ongoing operations. The permanent (post-closure) cover will be designed to minimize long-term infiltration and support vegetation to provide erosion resistance. Consideration will be given to an internal vertical drain (as utilized successfully at the on-site Soil Lead Repository) to capture and convey incident precipitation on the active top surface of the repository to the ponds treatment system during the active life of the repository.

Leachate Control. A liner and leachate collection system will be designed to intercept precipitation that infiltrates into the repository and pore water released from the placed treatment solids. The intercepted leachate will be conveyed to the ponds treatment system. The preliminary design concept for the liner and leachate collection system is summarized as follows:

- Graded and compacted subgrade
- Basal cushion layer of appropriately graded sand to fine gravel
- Geocomposite liner (GCL; e.g., Bentomat or Claymax)
- Drainage layer of graded sand and gravel overlain by a filter layer of graded sand compatible with the overlying treatment solids and underlying drainage material
- PVC piping to convey collected leachate by gravity to ponds treatment system

The minimum hydraulic capacity of the drainage layer and piping will be based on the results of the HELP modeling discussed previously and analysis of the long-term consolidation of the treatment solids in the repository utilizing the SIGMA/W (and if necessary the SEEP/W) software by Geo-Slope International, or equivalent software. The hydraulic design of the drainage system will utilize calculations based on Darcy's equation to size, slope and select the appropriate gradation for the drainage layer; collection and conveyance piping will be sized and sloped based on standard pipe flow equations.

Slope Stability. As discussed previously, the type of repository (wet-conventional versus dry-stacked) will depend on the dry density (and associated shear strength) of the treatment solids at the time of final placement in the repository. A wet-conventional repository would involve constructing a conventional earthen-diked basin to contain solids that have not been adequately dewatered and consolidated. Based on prior laboratory and pilot-scale field studies, and the currently proposed primary in-pond and subsequent dewatering and consolidation of treatment solids in a drying facility, it is assumed that a dry-stacked repository design will prove feasible. The following discussion is based on this assumption.

The design of a dry-stacked repository will address: 1) the anticipated shear strength of the placed treatment solids; 2) the materials and geometry of the liner system; and 3) the inclination of the exterior slopes of the repository. If necessary to achieve the design factors of safety noted previously, consideration will be given to the use of tensile reinforcement within the placed treatment solids (e.g., geogrid or granular soil layers). The stability of the repository will be evaluated utilizing the SLOPE/W software by Geo-Slope International. Loading cases to be analyzed (and the associated minimum required FS) will include: short-term loading during active operations (pre-closure period) – FS_{min} = 1.3; long-term loading at full build-out (post-closure period) – FS_{min} = 1.5; and seismic loading – FS_{min} = 1.0 (based on an appropriately conservative pseudo-static analysis).

Design Documentation. The design of the treatment solids repository will be documented in an Engineering Design and Operations Report (ED&OR) for submittal to EPA as an amendment to this Work Plan and to Dolores County and CDPHE as discussed under Solids Repository Permitting below. A sample table of contents for the ED&OR is presented in Table 5-1.

Upon approval of the ED&OR and issuance of a CD (as described in the Section 5.2.1.5, construction drawings and technical specifications will be prepared as the basis for construction as described in Section 5.2.2.

5.2.1.5 Solids Repository Permitting

Permitting for the treatment solids repository will involve preparation and submittal of a Development and Land Use Application (DLUA) and an application for a Certificate of Designation (CD) to Dolores County and CDPHE. Table 5-2 presents a summary of the permitting process, including major tasks/milestones, key subtasks, relevant issues/comments and the anticipated durations of each task/subtask.

A CD application will be made for construction of the repository subgrade, liner/leachate collection system, and placement of the existing precipitation solids removed from the upper ponds (and temporarily staged in the interim drying facility). The ED&OR will also address post-removal action of new treatment solids in the permanent drying facility and then into the solids repository following adequate dewatering and consolidation. The ED&OR accompanying the application will describe potential alternative placement methods, slope configurations, and stabilizing elements (e.g., external slope buttress; internal tensile reinforcement; etc.) that may be implemented pending the testing and evaluation of dewatered and consolidated treatment solids during the first several years of full-scale operation of the ponds treatment system and permanent drying facility. An amendment will be prepared and submitted to Dolores County and CDPHE describing the final selected repository slope configuration and stabilizing elements (if any) prior to placement of newly generated treatment solids.

5.2.2 Subtask B2 – Solids Repository Construction and Initial Solids Placement

Construction activities for the repository will commence following issuance of the DLUA and CD by Dolores County. Construction will proceed in the sequence and utilizing approved means and methods as identified in the ED&OR, construction drawings and technical specifications. The work will include the following primary construction activities: 1) construction of the subgrade improvements, runon controls, liner system, and initial berm/buttress constituting the primary solids repository; 2) construction of the permanent drying facility (described in Section 5.1); and 3) placement of solids from the interim drying facility into the prepared repository, including external buttressing and/or internal reinforcing elements if/as needed.

The activities of the selected construction contractor will be overseen by Atlantic Richfield on a full-time, on-site basis. Depending on actual conditions encountered during the course of the work, appropriate adjustments in the means and methods of construction and/or initial placement of solids may be identified. Any such adjustments will be presented to the Agencies for timely review and approval, and upon approval, implemented by the construction contractor.

In addition to observing the quality of the work, Atlantic Richfield oversight will also track and record the depth and volume of solids removed from the interim drying facility and the location and time of placement in the solids repository. Periodic surveys will be made of the solids deposited in the repository to document the amount and rate of ongoing consolidation.

An ongoing assessment will also be made of the need for control of dust from the repository. If necessary, the surface of the repository will be treated with a light water spray, a suitable dust suppressant, or if appropriate and otherwise necessary, with a reinforcing element.

5.3 Task C – Investigation of Collapsed Area of St. Louis Tunnel Adit

Objectives

The primary objectives of the investigation of the collapsed portion of the St. Louis Tunnel Adit immediately above the portal structure are to: 1) assess the possible accumulation of settled solids and groundwater build-up behind the existing rubble blockage in the collapsed area; and 2) to provide information to support design of an appropriate hydraulic control system(s) as discussed in Section 5.4 under Task D.

Background

A portion of the St. Louis Tunnel immediately behind the existing masonry block portal structure has collapsed, apparently due to borrowing of the overiying colluvium/talus deposits. The current condition is a tangle of broken timbers and lagging among a heterogeneous mix of sand to boulder size blocks resulting in unstable voids of varying size and shape. The discharge from the tunnel is impeded at the east (upgradient) end of the collapse such that flow is observed at approximately the former tunnel roof level. This flow then falls and works its way through the collapse to exit at the original tunnel floor grade in the still standing portal structure. As a result of this condition, there may be an accumulation of debris or precipitated solids near the adit opening.

5.3.1 Subtask C1 – Investigation Actions

5.3.1.1 Compile, Review and Evaluate Existing Data

Existing information on the grade and alignment of the St. Louis Tunnel (from existing mine plans) and on the geology of the portal area from previous site exploration and additional exploration planned under Task B will be compiled, reviewed and evaluated to support the investigations under this task and the preliminary design of hydraulic controls under Task D.

5.3.1.2 Detailed Survey and Site Reconnaissance

A detailed topographic survey of the collapsed area will be conducted and a map prepared at a contour interval of one (1) foot or less. The survey will be performed using conventional (total station or survey-grade GPS) techniques unless it is determined that direct access onto the collapsed rubble is not safe. In that event, the feasibility of access utilizing a mobile telescopic or articulated man-lift will be evaluated. Given the existing topography at the RTOU, it appears that this approach would be limited to the downgradient end of the collapse without grading an access platform between the toe of the soil lead repository and the collapsed area. If conventional sun/eying proves infeasible, then ground-based Lidar will be used. Set-up locations for the Lidar equipment appear feasible on the soil lead repository.

In addition to surveying the surface of the rubble, detailed panoramic digital photographs will be taken and video recorded with recognizable temporary bench marks visible for which coordinates and elevation are known. The presence, location (with coordinates and elevation to the extent feasible), character (color, presence of suspended solids or turbidity), and estimated flow rate of any visible flow or seepage within the collapse area will be recorded to the extent safe and feasible.

5.3.1.3 Assessment Options

The feasibility of drilling a horizontal boring to intersect the St. Louis Tunnel just upgradient of the collapsed portion of the tunnel above the portal will be evaluated. A platform for the drilling rig would be constructed by grading either on the slope just north of the collapsed area or on the adjacent soil lead repository to the south. The objective of the boring is to observe if precipitated solids are encountered within the tunnel, either by discharges from the tunnel in the drill pipe, or by camera survey if no discharges occur. Drill pipe diameter will be selected in coordination with identification of a suitable pipe inspection camera system. Pipe diameter as small as two (2) inches is feasible with a push system, but deployment length is typically limited to 200-300 feet. A crawler system typically requires at least a four (4)–inch pipe diameter, but length is not a limiting factor in this application.

If drilling an exploratory boring is determined not feasible, or if conditions in the tunnel remain uncertain even with an exploratory boring, then an approach of staged, protected excavation of the collapsed portion of the adit would be evaluated under Task D.

5.3.2 Subtask C2 – Adit Portal Investigation Report

A technical memorandum (TM) summarizing the findings of the investigation will be completed. The TM will include the topographic map, photographs, and a log of the exploratory boring (if drilled). If a camera survey is performed, a video and extracted photographs will also be provided.

5.4 Task D – Preliminary Design of Hydraulic Controls of the Adit Discharge

Objectives

The primary objectives for hydraulic controls of the adit discharge are to: 1) gather and convey tunnel discharge to the ponds treatment system in a controlled manner; and 2) mitigate the risk of release of settled solids and debris that may have accumulated in the St. Louis Tunnel behind the blockage in the collapsed adit area.

Overview

This task will involve developing and evaluating hydraulic control concepts and then carrying the selected concepts forward to the 30-percent design level. The design of these hydraulic controls will be integrated with the 30-percent design of the water treatment system under Task E. Final design and construction of the hydraulic controls are not included in this scope of work as they need to be fully integrated with the final design and construction of the inflow facilities for the water treatment system.

5.4.1 Subtask D1 – Develop Hydraulic Control Concepts

Based on existing information and preliminary consideration of this issue, the following concepts will be further characterized and evaluated to meet the objectives noted above:

- Local excavation of collapsed debris immediately upgradient of the existing masonry block portal structure; grading and local lining of a collection basin for tunnel discharges to capture and direct flows through the existing portal structure; upgrading of conveyance through the structure if necessary; and integration with the inlet channel downgradient of the portal structure and to the upgraded ponds treatment system.

- Depending on the results of the investigative boring described in Task C, enlarge the pilot bore (likely requiring drilling a new bore) and install a permanent pipe drain sized to prevent build-up of head within the lower St. Louis Tunnel/CHC Hill; construct the pipe with a vertical riser as the pressure control measure, and provide means to convey any flows/solids discharging from the drain pipe to the ponds system for treatment.
- Evaluate the need and practicality of constructing a surge basin within the collapse area as a back-up to detain flows and drop out solids should a release of materials accumulated behind the collapsed portion of the adit occur; this would involve constructing a lined earthen dike at the upgradient end of the catchment basin noted above, with a lined spillway section to convey flows over the dike and into the basin in a controlled manner.
- Based on considerations to date, it does not appear safe, practical or necessary to remove all of the rock and debris within the full 200-foot long collapsed area upgradient of the proposed collection basin; in fact, the debris may serve to some extent as erosion protection.

5.4.2 Subtask D2 – Develop 30-percent Design of Adit Hydraulic Controls

The selected adit area hydraulic control concepts will be designed to the 30-percent level based on the results of Task C and Subtask D1. The objective of the 30-percent design is to confirm the technical feasibility of the selected concepts in terms of: 1) constructability given site physical and environmental (weather) conditions; 2) location of major components and their relationship to other project facilities and existing infrastructure at the RTOU; and 3) key materials required for construction. The 30-percent design will include the evaluations and analyses and work products described in the following paragraphs.

5.4.2.1 Evaluations and Analyses

Previous evaluations of the anticipated range of discharge flows from the St. Louis Tunnel will be reviewed and revised or updated as necessary. These evaluations will utilize the existing predictive model developed from historic tunnel discharge, ponds system discharge, and Dolores River flow measurements. The predicted range of flows will be utilized as input in sizing and designing the collection system described under Subtask D1. Collection basin capacity and conveyance will be analyzed utilizing standard hydraulic equations and/or simplified routing models.

If necessary based on the results of the investigations described under Task C, evaluation of concepts under Subtask D1, and review of relevant literature (to the extent available), an assessment will be made of the potential rate and volume of a release of settled solids from the tunnel at the upgradient end of the collapsed area above the portal structure. The estimate of release rate and volume would be used to size and design the catchment dike described under Subtask D1.

5.4.2.2 Work Products

The 30-percent design will be documented in a Technical Memorandum (TM) including the following information and work products:

- Narrative discussion of site investigations, concept development, 30-percent design level evaluations and analyses, and intended operations (both normal and emergency conditions)

- Description of key work items and components to construct the hydraulic controls, including component sizes (key dimensions), capacities, and materials
- Layout drawings of hydraulic controls, including plan, sections, and preliminary details

The TM will be submitted to EPA as a future Work Plan Amendment or as an attachment to the final report required under the AOC.

5.5 Task E – Development of a 30-Percent Water Treatment System Design

Objectives

The primary objectives of the 30-percent design of the water treatment system are to: 1) provide design criteria that allow the system to meet the overall objective stated in Section 1.0 for this Removal Action; and 2) describe the water treatment system and its components to a 30-percent level, as further described in this section.

Overview

Development of a 30-percent design for the water treatment system will involve: a) comprehensive review and evaluation of relevant prior studies and data; b) establishing the design criteria for the system; c) identifying and describing the system components and operations; and d) preparing 30-percent design documents. Completion of the design and construction of the water treatment system will be performed outside the scope of this Work Plan.

5.5.1 Subtask E1 – Design Evaluations and Development of Design

5.5.1.1 Compile, Review and Evaluate Existing Data

Existing information, studies and conceptual designs relevant to development of a water treatment system to the 30-percent design level will be compiled, reviewed and evaluated. This will include applicable information from the studies described in Section 4.0, and from design and long-term operation of other open pond, lime addition mine water treatment systems including the Warm Springs Ponds and Lower Area One systems designed and operated by Atlantic Richfield in Montana.

5.5.1.2 Design Criteria for the Water Treatment System

Discharge Water Quality. The 30-percent design of the water treatment system will be based on the preliminary permit limitations derived from the Water Quality Assessment (WQA) for the St. Louis Tunnel discharge. The WQA will form the basis for development of a Colorado Discharge Permit System (CDPS) permit for ponds system discharges to the river outside the scope of this Work Plan. The WQA accounts for multiple flows and loading sources from the St. Louis Tunnel and ponds area to the Dolores River, including natural groundwater and existing pond seepage.

System Hydraulic Capacity. The water treatment system will be designed to treat water discharged from the St. Louis Tunnel at the range of flows and conditions anticipated over the design life of the system (50 to 100 years). The normal operating flows adopted for 30 percent design will be based on the monthly design discharge capacities established in the WQA, plus 0.6 cfs to account for currently estimated evaporation and seepage losses from the ponds system. These flows will be reviewed and appropriate adjustments made based on refinement of the tunnel discharge predictive model as described under Task D and refined evaporation and seepage estimates to be developed under this task. The maximum instantaneous flow to be accommodated in the 30 percent design will be based on the estimated maximum discharge appropriate to the project design life as derived from the predictive model; at a minimum, the design will accommodate the historic maximum recorded tunnel discharge of 2200 gpm.

The monthly tunnel discharges to be used for design as described above reflect the fact that water discharged from the St. Louis Tunnel is a result of precipitation (primarily snowmelt) followed by infiltration to the connected mine workings. The rate of discharge from the tunnel generally parallels the flow rate in the Dolores River; that is, as a rule, when the tunnel discharge is high so is the Dolores River flow and when the tunnel discharge is low the river flow is also low, with the tunnel flow extremes dampened and slightly lagging when compared to the river.

Ponds Integrity. The existing embankments will be retained to the maximum degree technically feasible. Embankments will be rehabilitated as necessary to meet operational needs and dam safety requirements. The key design criteria will include industry standard and/or state dam safety mandated factors of safety (FS) against slope failure under applicable loadings (long-term static/steady seepage; short-term/construction phase; and earthquake), and protection against internal erosion (piping) of embankment material due to seepage flows. As part of demonstrating pond embankments meet appropriate integrity standards, the hydraulic structures will also be evaluated. The key evaluation and design criteria for the hydraulic structures will be industry standard and/or state dam safety mandated storm water (i.e., "flood") flows, and protection (to the degree practical) of normal flow outlet piping against blockage by beavers.

Operability. Because of the remote nature of the RTOU, the treatment system should be designed to be simple, reliable and easy to operate with minimal on-site operations personnel. Other consistent operability goals include low maintenance, infrequent solids handling, and remote monitoring, operation and control.

These operational criteria are required to accommodate the following conditions: 1) the RTOU is located in a remote region of the San Juan Mountains near the Town of Rico which has a population estimated to range from 200 during the winter to 500 in the summer; 2) the nearest urban center with significant population is Cortez which has a population of approximately 8,300 and is 45 miles (and over one hour travel time during good weather) from Rico; and 3) the RTOU is at an elevation of approximately 8800 feet and during the winter is frequently accessible only by snowmobile or by foot (unless a more permanent and consistent snow plowing effort is undertaken).

5.5.1.3 Surface Water Sampling Program

A surface water sampling program will be implemented to further characterize the seasonal water quality and flow rates of the St. Louis Tunnel discharge, selected locations within the ponds system, and several locations along the mainstem Dolores River (the receiving stream for the ponds system discharge). Table 5-4 summarizes the sampling locations; these locations are shown on Figure 5-3. The planned sampling locations have been sampled historically so that existing water quality data can be compared for most of the planned parameters listed in Table 5-5. –. Sample analyses will be performed according to methods specified in 40 CFR, Part 136 or other methods acceptable to EPA.

Flows will be measured by one of five methods depending on conditions at the time of sampling: 1) a portable flow meter using the six-tenths-depth method; 2) existing Parshall flume(s); 3) volumetric procedure using a suitable size bucket and stopwatch; 4) portable Parshall flume or V-notch weir; or 5) the float method (per USBR Water Measurement Manual).

River flow/runoff at the USGS Dolores River gauging station downstream of Rico (Gage No. 09165000) will be regularly evaluated to identify and document representative seasonal flow rates. For purposes of this Work Plan, three sampling periods per calendar year have been identified: 1) January or February which represents low flow conditions; 2) May or June which represents high-flow conditions; and 3) September or October which represents moderate to low-flow conditions. This schedule should provide representative analytical and flow data across the annual cycle of conditions for the RTOU and receiving stream.

5.5.1.4 Identify and Describe Treatment System Components and Operations

Flow-Based Lime Addition Control. The range of pH required for optimal operation based on studies to date is between 8.5 and 9.5, with an initial treatment target pH of 9.0. A dosage control concept will be evaluated and characterized to determine if it will facilitate a stable treatment target pH. The flow rate of the collected tunnel discharge would be measured ahead of pH adjustment at the new lime addition facility to enable automatic pacing of lime feed based on incoming flow.

Lime Storage System. Lime storage capacity will be evaluated during 30-percent design to establish practical sizing. Factors to be considered will include frequency of shipments and reasonable storage life. If practical (with consideration of storage life), lime storage will be based on providing sufficient capacity to continue treatment without additional lime shipments using the maximum expected dosage and during a 30 to 60 day period of peak discharge (late spring/early summer) and/or throughout the winter (when typically lower dosage rates are anticipated). The existing lime silo will be evaluated in terms of its ability to meet the needs of the newly designed system; the silo would be upgraded or replaced to meet the new design requirements. The feasibility of equipping and reusing the existing lime feed building will also be evaluated relative to its condition, size, and suitability. Improvements to the existing access road into the RTOU will also be designed to enable delivery of lime with a suitable turn-around loop near the lime silo.

New Lime Addition Facility. A new hydrated lime facility (as opposed to the original slaked lime system) will be designed to add lime to the tunnel discharge upstream of the first (primary) settling pond. The current concept to be reviewed and refined is for lime to be added continuously and at a rate proportional to incoming flow at a capacity capable of attaining a pH of 8.5 to 9.5 ahead of the first treatment pond.

Lime Addition Capacity. Lime requirements will be based on bench-scale testing completed to date (and possibly additional verification testing) on tunnel effluent. Maximum feed rates will be based on providing lime dosage required to obtain a pH of 9.5 on tunnel discharge unless an alternate target is identified during the course of the 30-percent design effort. Use of commercial (versus laboratory) grade lime will be evaluated in terms of utilization efficiency versus cost. Maximum lime feed capacity will be based on the design maximum peak discharge from the tunnel determined as described in Section 5.5.5.2, and assuming dosage rates based on adjusting influent from the tunnel to the target pH range.

Solids Precipitation in Ponds. Due to site constraints including steep topography and limited open area, the efficient use of available space is desirable. This includes optimizing use of available in-pond solids settling area and volume. Based on studies to date, it appears that only a few ponds will be required to provide reliable solids settling for treatment purposes. Two pond configuration alternatives will be considered for the primary solids precipitation: 1) existing configuration with Pond 18, then Pond 15 as primary settling ponds; and 2) Pond 18 and a new pond to be constructed in the currently off-line, largely filled Ponds 16 and 17 as the primary settling pond (as discussed further below). The design will provide for settling of at least 90-95 percent of the solids in the primary settling pond(s), with the remainder of the ponds providing backup settling or "polishing" of the effluent. The potential for immediate settling of solids after lime addition will be considered in the evaluation and design of the location of lime addition relative to the first (primary) settling pond.

Flow Sequence. Alternatives for the primary settling pond and the sequence of flow through the remaining ponds to the point of discharge to the Dolores River will be evaluated in terms of: 1) constructability; 2) detention time; 3) maintaining gravity flow throughout the system; and 4) compatibility and coordination with other project facilities and operations (especially on-site enhanced drying and disposal of settled solids).

Two design alternatives are under consideration. As shown on Figure 5-4, Alternative 1 would utilize the existing Pond 18 as the primary settling/initial consolidation basin receiving lime amended inflows from the St. Louis Tunnel. Pond 16/17 would not be constructed under Alternative 2, and would thus be available for use as the permanent drying facility site. This alternative would have the same flow path as Alternative 1 downgradient of Pond 18.

As shown on Figure 5-5, Alternative 2 will add a newly reconstructed Pond 16/17 ahead of the existing Pond 18. From Pond 16/17, flow will be routed through Pond 18, followed by Ponds 15, 14, 12-11, 9, 10, 8, 7, 6, and 5 before discharge to the river. This area lies directly east of the existing settling Ponds 15 and 18. It has the advantage of being close to the existing ponds and the potential permanent drying facility in Pond 13 (if selected). The bottom of the pond would be located above surrounding high groundwater levels facilitating gravity drainage during periods of in-pond initial dewatering and consolidation.

Polishing Treatment. The lower ponds (below Pond 11) in the existing system are generally free of accumulated solids and have developed wetlands which may help improve treated discharge water quality. Unless a reason arises during the 30-percent design process indicating otherwise, these existing ponds would be maintained on the hydraulic flow path for passive treatment and provide a buffer against upset conditions in the upper ponds.

5.5.1.5 Planned Pond Upgrades

Utilize Existing System to the Maximum Degree Practical. Both pond configuration Alternatives 1 and 2 include retention of the majority of the existing ponds and embankments, and reinforcement and/or upgrading of embankments, if necessary, to ensure stability. Existing hydraulic structures will be evaluated to determine if they need altering or replacing. Finally, providing bypass piping around certain ponds or groups of ponds will be evaluated. Pond configuration Alternative 2 would also include adding a new primary treatment pond upstream of Pond 18 in the vicinity of historic Ponds 16 and

17. Currently off-line Pond 10 could also be brought on-line to add additional detention/polishing for either Alternative 1 or 2.

Pond Embankments. The existing embankments will be retained to the maximum degree technically feasible and rehabilitated as necessary to meet operational needs and dam safety requirements. At present, it is envisioned that any necessary upgrades would be constructed on the downstream slopes and at the downstream toes of existing embankments. Typical measures would likely include: stripping and compacting the existing slope and toe area; placing a filter blanket and if necessary an overiying drainage blanket on the prepared stripped surface; and placing fill as necessary to protect the filter/drain zones and to meet required factors of safety against downstream slope failure under appropriate loading conditions. Where appropriate, drainage relief and/or piping protection will be provided in the downstream toe foundations.

Pond 16/17 Embankment. Under pond configuration Alternative 1, the Pond 16/17 area will be used for the permanent solids drying facility. Under pond configuration Alternative 2, a new embankment would be constructed around the current Ponds 16 and 17 to create a new primary settling pond. Foundation improvements would be designed and constructed if/as necessary (e.g., removing locally unsuitable material; providing for pore pressure relief and/or piping protection). The embankment would be constructed using standard design measures and construction methods appropriate to the borrow materials available to provide for slope and foundation stability, seepage control, and protection against internal erosion (piping).

Hydraulic Structures. New outlet structures and overflow spillways will be considered in each of the major ponds (Ponds 11, 15, 16/17 and 18), and Pond 10 if added to the flow path. Outlet structures will be provided with adjustable overflow weirs to regulate pond level. An emergency overflow spillway (independent of the outlet structure) will also be provided to handle excess flows or in the event that the normal outlet structure should become plugged. Bypass piping will be provided on certain ponds to enable bypassing of the subsequent downstream pond. Structures will be designed if necessary to meet operational needs, and for those ponds under SEO jurisdiction, in accordance with applicable dam safety rules and regulations.

5.5.1.6 Solids Removal Cycling

Periodically (on the order of once every two to three years) solids will be consolidated in-place within the uppermost (primary) settling pond to reduce the solids volume and restore a portion of the settling volume and detention time. During the period when solids are being consolidated (estimated to require approximately one to two months), the flow from the primary settling pond will be diverted to the second pond in series, which will provide primary settling during the consolidation phase. Surface water will be decanted from the uppermost pond to the second pond in series. Ongoing seepage and evaporation in the absence of tunnel water influent to the off-line settling pond will allow the consolidated solids to dewater. Prior bench scale and field testing to date indicates that consolidation in this manner should reduce the settled solids volume to approximately fifty percent of its initial volume (thereby doubling the density of the settled solids to approximately twenty percent solids by weight). Over time (approximately every two to three in-pond consolidation cycles, or on the order of every four to nine years) the volume available for settling post consolidation will decrease. When this occurs, the consolidated solids will be removed from the primary settling pond to fully restore its initial settling volume and detention time. The initially dewatered and consolidated solids would then be removed and placed in the permanent drying facility prior to disposal in the on-site repository.

5.5.1.7 Automated Monitoring System

An evaluation of the technical feasibility, advantages and potential operational or maintenance issues of automated monitoring and recording of key treatment process parameters will be conducted. Based on studies to date, the following parameters would be included in the evaluation:

- Flow discharged from the tunnel
- Flow from the final outfall into the Dolores River
- pH of effluent from the uppermost primary settling pond and the ponds system effluent to the Dolores River
- Lime feed rate

A control system will be developed for automatic flow proportional lime slurry feed based on the flow discharge from the St. Louis Tunnel, and an operator dosage selection.

Remote access to the monitoring data and lime feed control system will also be evaluated. Specific equipment types, methods and other details of remote monitoring and lime feed operation will be evaluated in terms of need, technical feasibility, reliability and cost.

5.5.2 Subtask E2 – Prepare 30-percent Design Documents

The 30-percent design of the water treatment system will be documented in a Technical Memorandum (TM) that will be submitted to EPA as a future Work Plan Amendment or an attachment to the final report required under the AOC. The TM wiil be comprised of a summary narrative describing the studies and results from the preceding subtasks, and the following work products: 1) comprehensive process flow diagrams; 2) a piping and instrumentation control diagram; 3) plan layout drawings of key facilities/features; and 4) preliminary equipment specifications. Each of these work products is described in the following paragraphs.

Process Flow Diagrams. The process flow diagrams will illustrate and characterize the key components in the flow path from the tunnel discharge, through the ponds treatment system, ending at the discharge into the Dolores River. Components to be included will include:

- Portal collection facility
- Conveyance to primary settling pond
- Inflow measurement structure
- Lime feeder and storage silo(s)
- Primary and supplemental settling ponds

Flow paths for normal operation and operations during periodic solids removal will be shown on separate diagrams. The design range of flow rates, lime feed rates, and pond volumes, detention times and solids capacities will be shown on the process flow diagrams and/or provided in accompanying tables.

A preliminary material balance will be included as a part of the process flow diagrams. This balance will identify design and normal flow rates for relevant water and treatment solids streams. The material balance will also list projected treatment efficiencies associated with the water treatment system.

The process flow diagrams will also show conceptual layouts for key piping and major equipment (i.e., pumps, mixers, vessels, etc.), and illustrate local and remote monitoring and control instrumentation and associated operational concepts for the water treatment system.

Plan Layout Drawings. Plan drawings illustrating the location and interrelationship of the treatment system facilities/structures will be prepared on the existing two (2)-foot contour topographic base map for the RTOU, with and without the latest available aerial photography for reference as appropriate. If necessary, notations will be made to indicate where topography has changed since preparation of the currently available mapping. In addition to the facilities listed above under Process Flow Diagram, the drawings will show the conceptual layout of: 1) access road(s), turnaround and parking areas for the lime storage and lime feed facilities; 2) process related buried piping alignments; and 3) existing and/or relocated utility lines (electrical power, telephone). The location and characteristics of structural and hydraulic upgrades to the existing ponds and pond embankments will be shown in plan and section, and key typical details will be included.

6.0 Land Ownership and Site Access

Performance of the tasks specified in this Work Plan will not require that Atlantic Richfield obtain additional access rights or agreements. The water treatment system will eventually be constructed and operated on parcels of land that currently include a mix of privately owned patented lode and placer claims, and U.S. Forest Service managed National Forest System lands located within San Juan National Forest. As design and construction phases proceed, Atlantic Richfield will arrange for acquisition of the necessary private patent claims or portions thereof from their present owners and of certain San Juan National Forest tracts from the Forest Service pursuant to the Small Tracts Act. The lime addition facilities, the ponds and the repository will be located on lands that will be transferred to the North Rico Trust. Atlantic Richfield will fund, own and operate the constructed water treatment system and treatment solids facilities.

The water treatment system facilities will be accessed using an existing road that currently is subject to a Forest Service Road Use Permit held by Atlantic Richfield. Upon consolidation and transfer of the subject lands to the trust, Atlantic Richfield will control use of the road to prevent interference with operation of the water treatment system.

7.0 Applicable or Relevant and Appropriate Requirements (ARARs)

The elements of the St. Louis Tunnel water treatment system to be designed, and for certain tasks constructed under the Removal Action will comply with Applicable or Relevant and Appropriate Requirements (ARARs) pertinent to the project. The ARARs address solid waste management and disposal, and ground water and surface water protection. These ARARs include substantive provisions of applicable or relevant and appropriate standards, requirements, criteria or limitations set forth in State of Colorado environmental and health and safety laws and regulations (including those that implement and administer delegated federal regulatory programs), as well as County of Dolores and Town of Rico land use and development regulations. Attachment 3 to this Work Plan identifies and summarizes the ARARs applicable to this site, and describes in detail how each such ARAR is or will be satisfied.

Tables

Table 5-1

Sample ED&OR Table of Contents

Table 5-2
Permitting Process – Treatment Solids Repository

Major Tasks/Milestones	Subtasks	Issues/Comments
1.0 Development and Land Use Application/Application for Certificate of Designation (Dolores County and CDPHE)	1.1 Prepare Engineering Design and Operations Report (ED&OR)	The ED&OR documents the design and operation of the treatment solids repositories and must accompany the DLUA/CD application
	1.2 Prepare and submit DLUA/CD application package	Documents required: Dolores County Application for Land Development, Project Overview, County Performance Standards Compliance Review, State Statute Review Standards Identification, Solid Waste Disposal Sites and Facilities Application Checklist, ED&OR, Financial Assurance, Application Fee
2.0 DLUA/CD Review	2.1 CDPHE Review for Application Completeness	This review will be led by CDPHE with input from Dolores County and will assess the completeness of the information submitted, not technical issues or financial security
	2.2 Comprehensive Technical Review and Public Hearing	This review will be performed primarily by CDPHE and focus on the ED&OR
	2.3 CDPHE/Hazardous Materials and Waste Management Division Recommendation for Approval to Dolores County	This is the formal recommendation by CDPHE to the County on acceptability of the DLUA/CD application, including technical matters and financial security
	2.4 Dolores County Issuance of Certificate of Designation	

Table 5-3 – Surface Water Sampling Locations

Site ID	Site Description

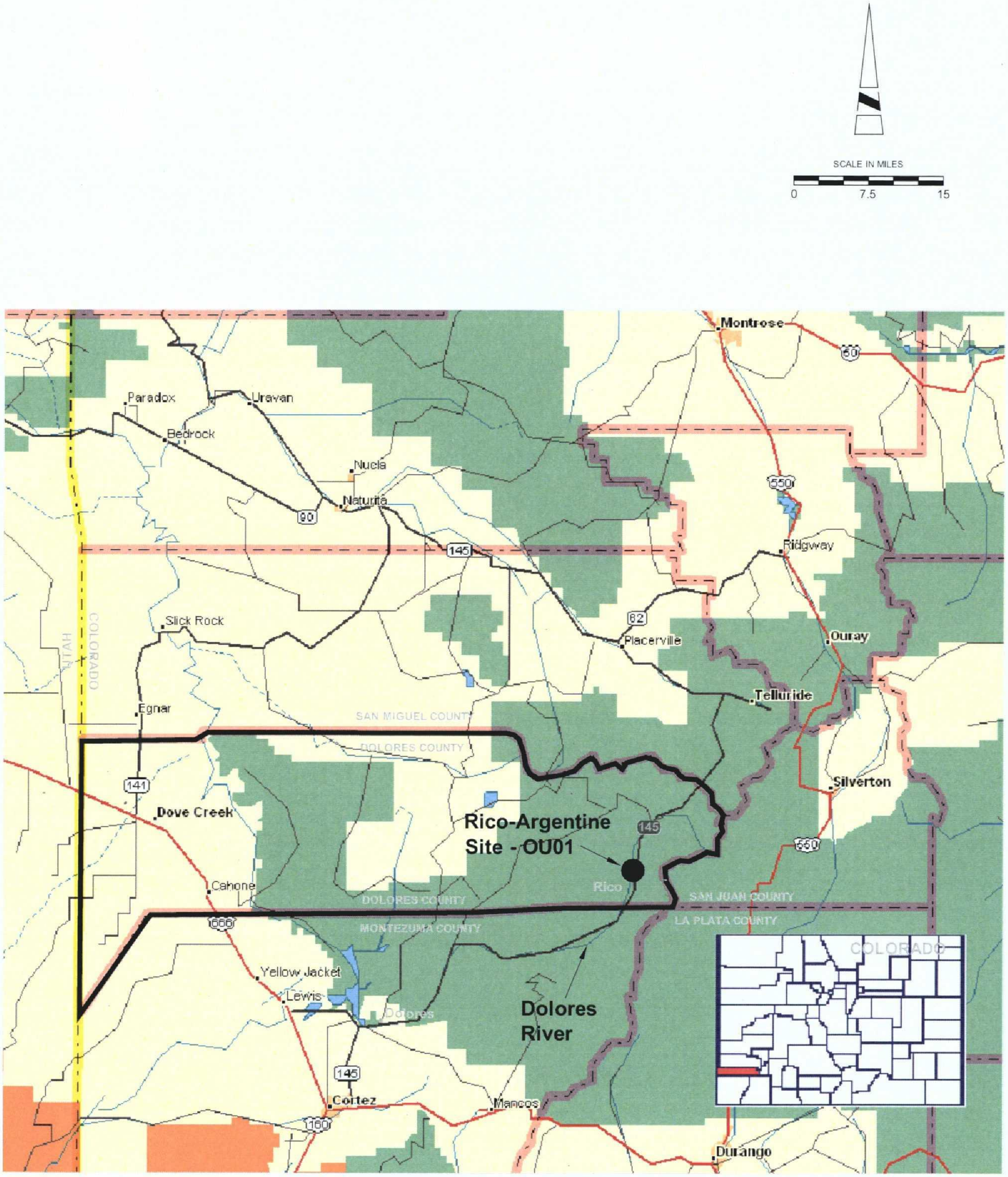
Table 5-3 – Surface Water Sampling Locations

Site ID	Site Description
DR-4-SW	Dolores River below Silver Swan
DR-1	Dolores River above St. Louis settling pond system
DR-2	Dolores River immediately above the St. Louis settling pond system outfall
DR-3	St. Louis tunnel discharge at adit
DR-4	Discharge of Pond 15
DR-5	Discharge of Pond 8
DR-6	St. Louis settling pond system outfall to the Dolores River (Outfall 002)
DR-7	Dolores River below St. Louis settling pond system outfall
DR-G	Dolores River at USGS gauging station #09165000

Table 5-4 – Surface Water Analyses

Field Analyses	Laboratory Analyses	
pH Temperature Conductivity	Alkalinity Hardness (total, Ca and Mg) Total dissolved solids (TDS) Total suspended solids (TSS)	Aluminum Antimony Arsenic Barium Beryllium Cadmium Calcium Chromium Cobalt Copper Cyanide Iron Lead Magnesium Manganese Nickel Potassium Selenium Silver Sodium Thallium Vanadium Zinc

Figures



AECOM AECOM Technical Services, Inc. 717 17th ST., SUITE 2600 DENVER, COLORADO 80202 T 303.228.3000 F 303.228.3001 www.aecom.com	RICO-ARGENTINE SITE - OU01 REMOVAL ACTION WORK PLAN	AECOM PROJECT NO.	FIGURE
	REGIONAL MAP	60157757	3-1

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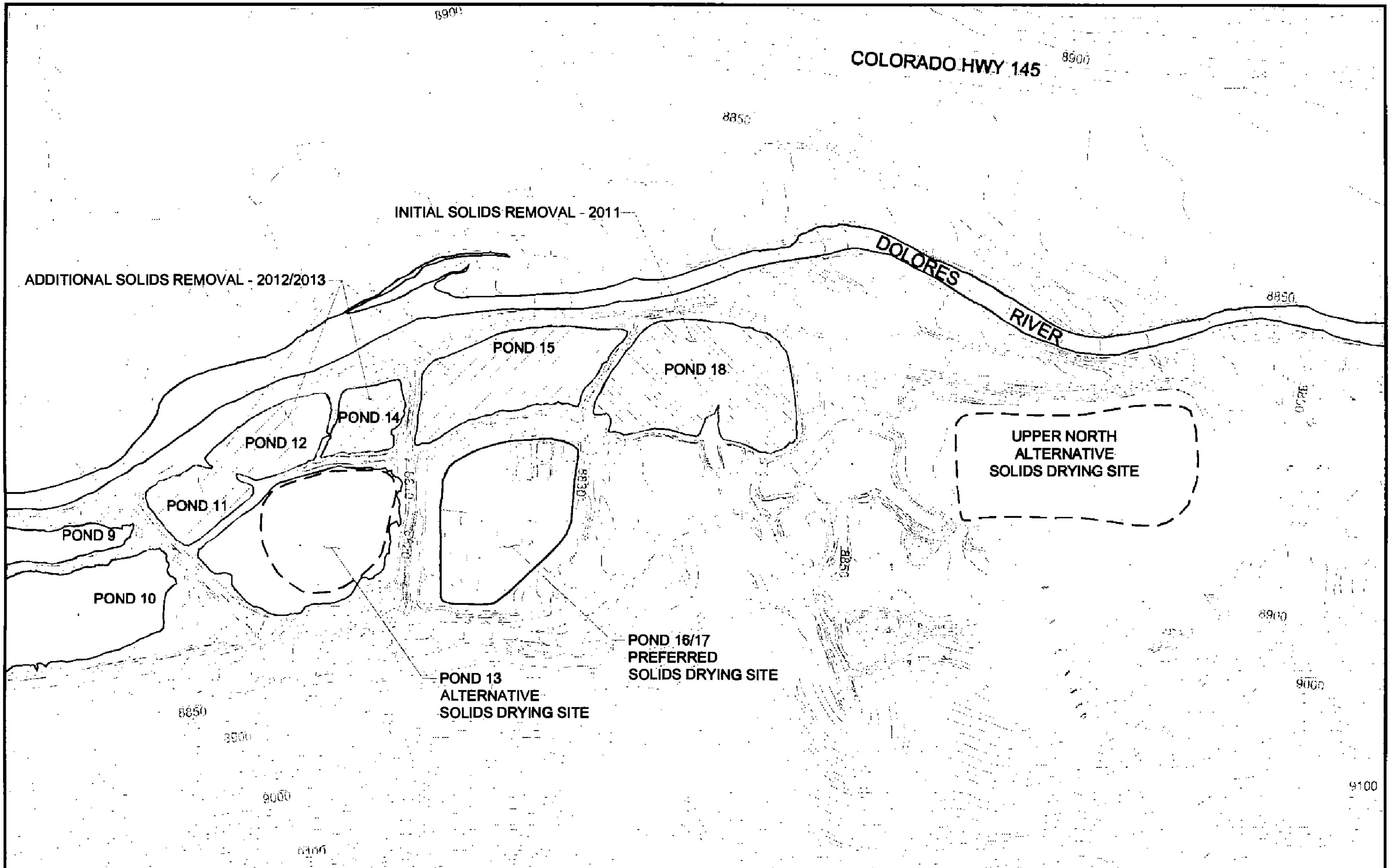
RICO-ARGENTINE SITE - OU01 REMOVAL ACTION WORK PLAN	AECOM PROJECT NO.	FIGURE
LOCATION MAP	60157757	3-2

AECOM AECOM Technical Services, Inc. 717 17th ST., SUITE 2600 DENVER, COLORADO 80202 T 303.228.3000 F 303.228.3001 www.aecom.com	RICO-ARGENTINE SITE - OU01 REMOVAL ACTION WORK PLAN SITE MAP	AECOM PROJECT NO. 60157757	FIGURE 3-3



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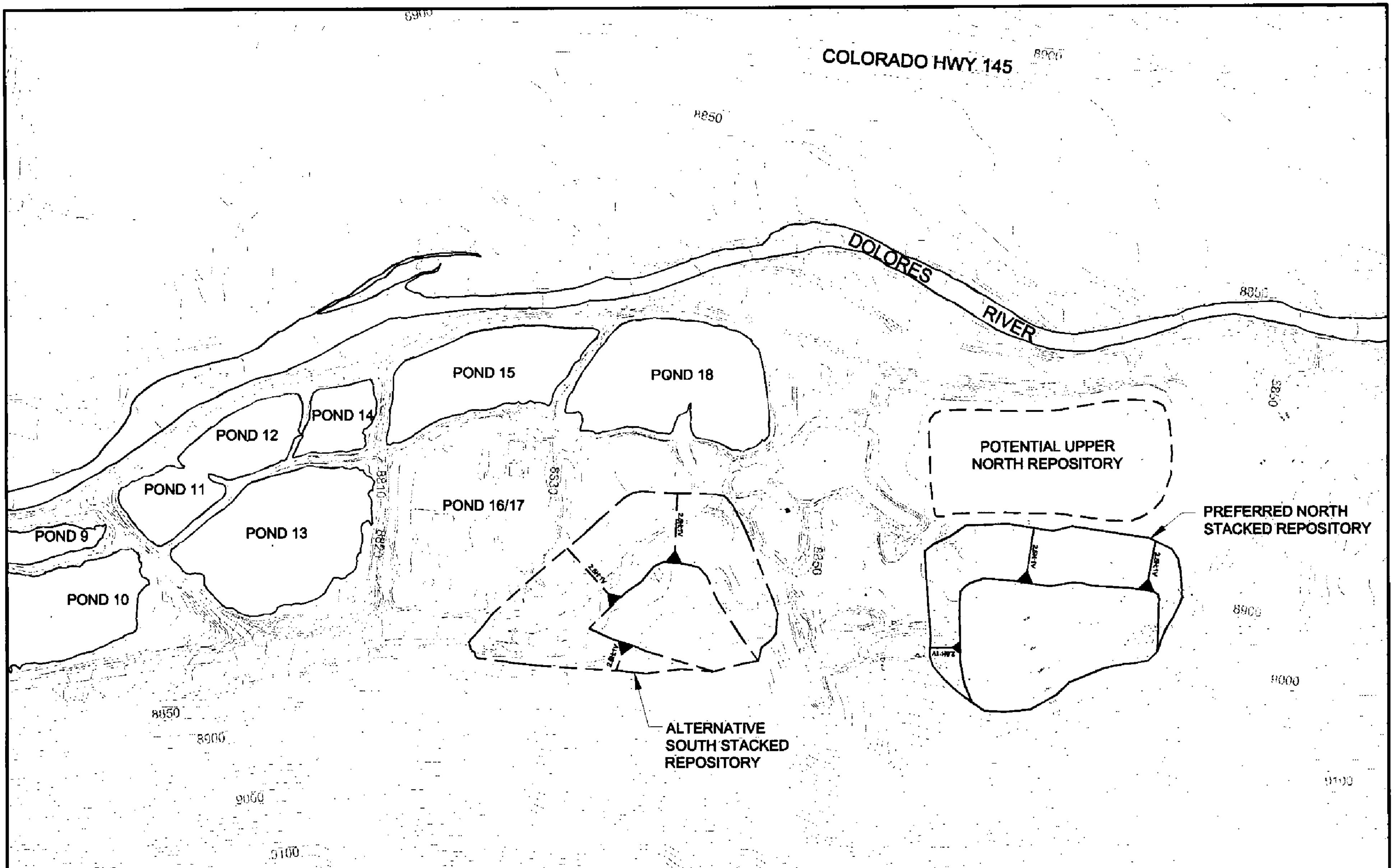
RICO-ARGENTINE SITE - OU01
REMOVAL ACTION WORK PLAN

INITIAL SOLIDS REMOVAL AND
SOLIDS DRYING SITES

AECOM PROJECT NO
60157757

FIGURE
5-1



SCALE IN FEET
0 150 300

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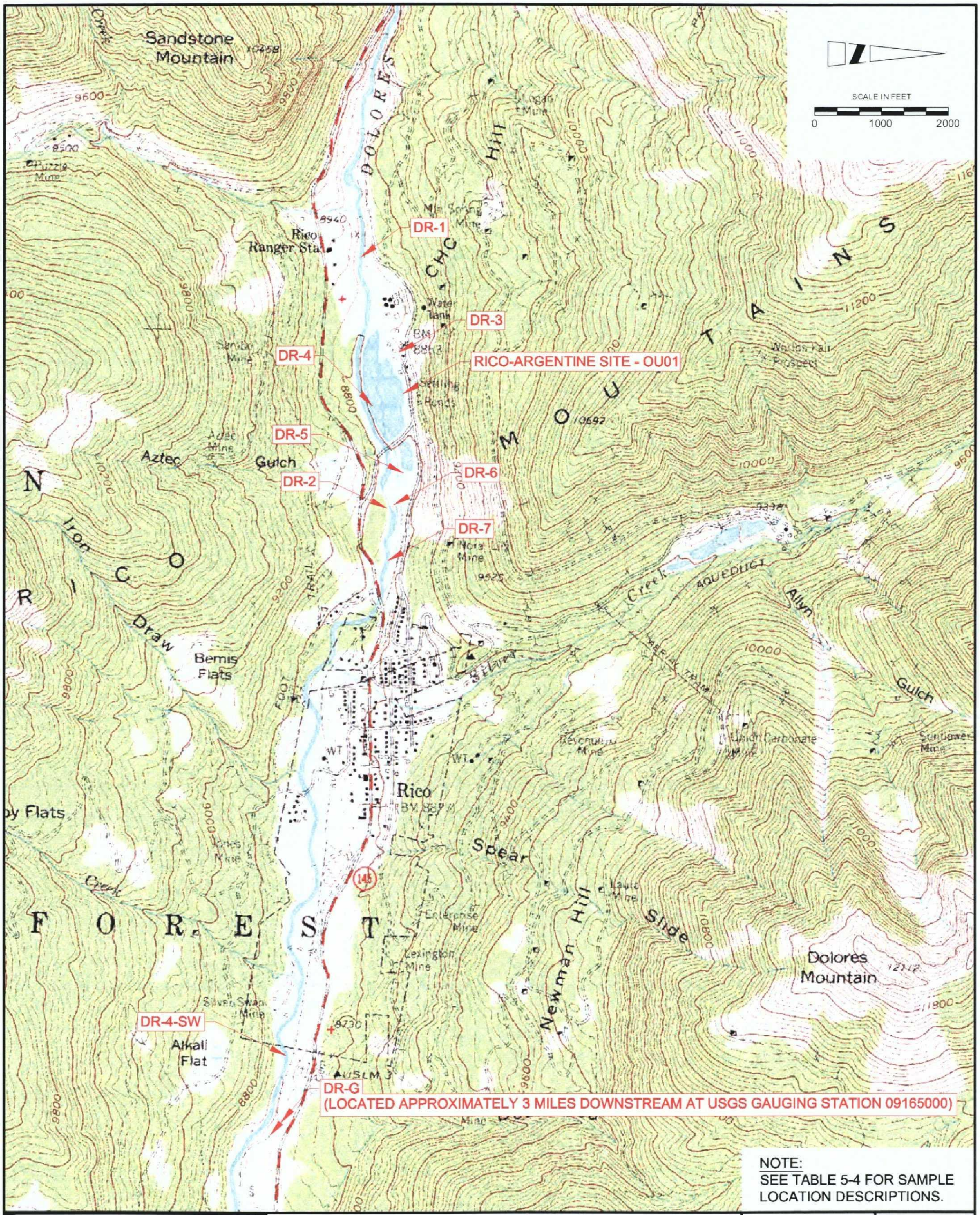
RICO-ARGENTINE SITE - OU01
REMOVAL ACTION WORK PLAN

SOLIDS REPOSITORY SITING

AECOM PROJECT NO	FIGURE
60157757	5-2



NOTE:
SEE TABLE 5-4 FOR SAMPLE LOCATION DESCRIPTIONS.

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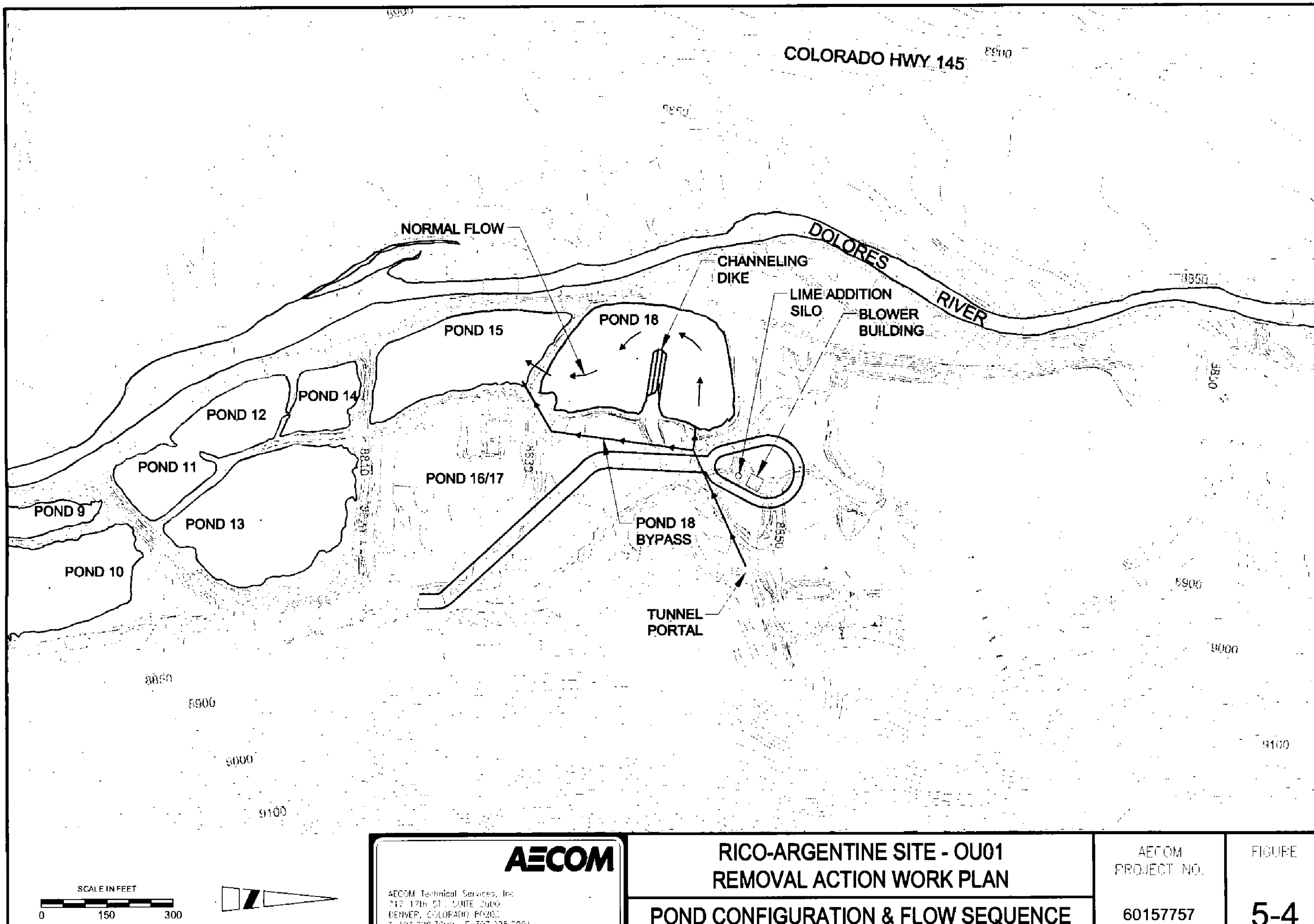
RICO-ARGENTINE SITE - OU01 REMOVAL ACTION WORK PLAN		AECOM PROJECT NO.	FIGURE
SURFACE WATER SAMPLING STATIONS		60157757	5-3



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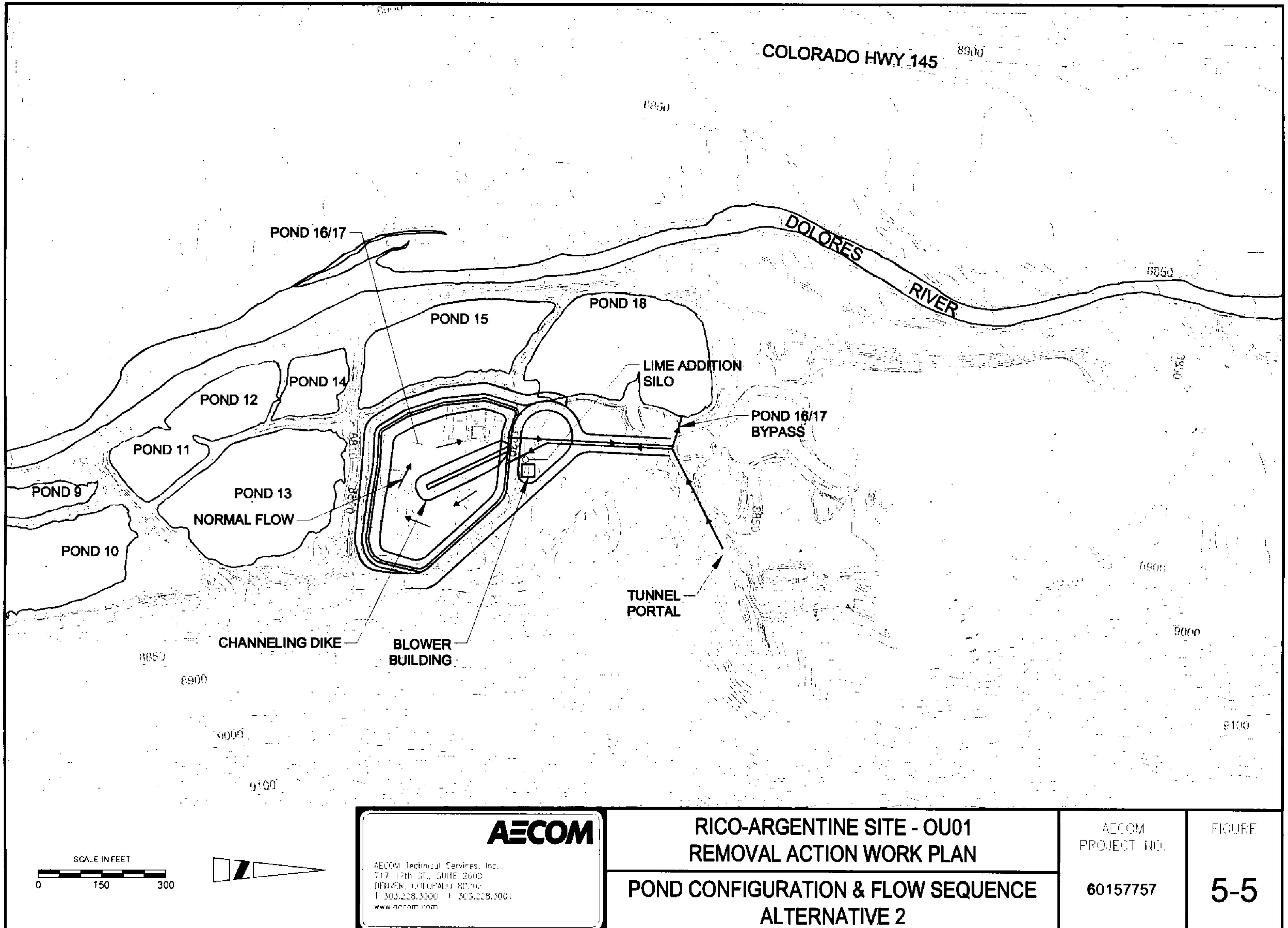
RICO-ARGENTINE SITE - OU01
REMOVAL ACTION WORK PLAN

POND CONFIGURATION & FLOW SEQUENCE
ALTERNATIVE 1

AECOM PROJECT NO. 60157757

FIGURE 5-4



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RICO-ARGENTINE SITE - OU01
REMOVAL ACTION WORK PLAN

POND CONFIGURATION & FLOW SEQUENCE
ALTERNATIVE 2

AECOM PROJECT NO. 60157757

FIGURE 5-5

Attachment 1

APPENDIX A
WATER QUALITY ASSESSMENT
MAINSTEM OF THE DOLORES RIVER
ST. LOUIS TUNNEL DISCHARGE

Table A-1
Assessment Summary

Name of Facility	St. Louis Tunnel
CDPS number	To Be Decided (Previous Permit CO-0029793 expired)
WBID - Stream Segment	San Juan River Basin, Dolores River Sub-basin, Stream Segment 03: Mainstem of the Dolores River from a point immediately above the confluence with Horse Creek to a point immediately above the confluence with Bear Creek. COSJDO03
Classification	Cold Water Aquatic Life Class 1 Class E Recreation Agriculture
Designation	Undesignated

I. Introduction

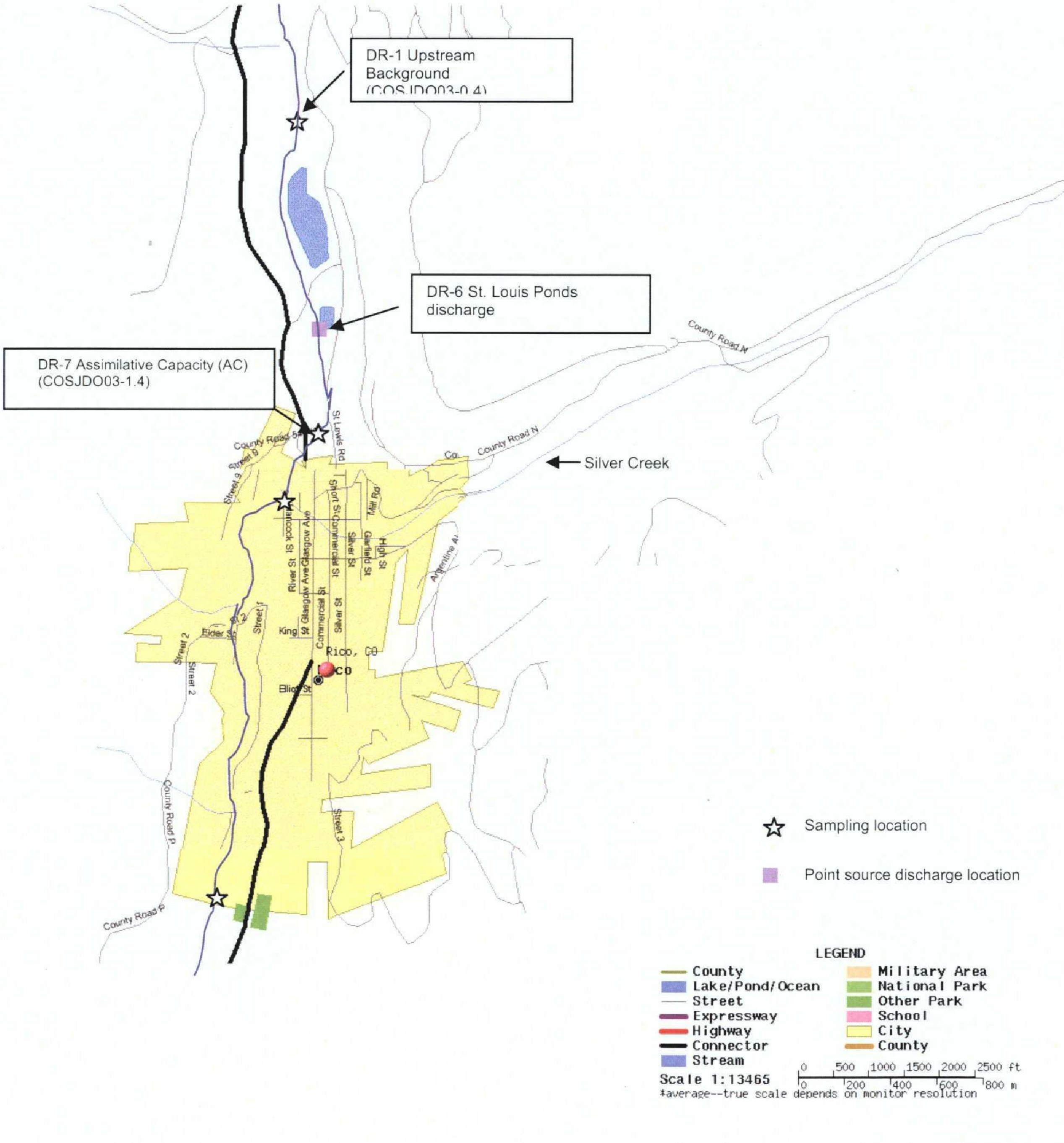
The water quality assessment (WQA) of the Dolores River near the St. Louis Tunnel discharge was developed by the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division (WQCD). The WQA was prepared to facilitate issuance of a Colorado Discharge Permit System (CDPS) permit for the St. Louis Tunnel, formerly covered under CDPS Permit No. CO-0029793, and is intended to determine the water quality-based effluent limits (WQBELs) and antidegradation-based average concentrations (ADBACs) available to the St. Louis Tunnel discharge for pollutants found to be of concem. This assessment provides potential effluent limits for the discharge of the St. Louis Tunnel.

The St. Louis Tunnel discharge is located north of the Town of Rico, upstream of the confluence with Silver Creek. The St. Louis Tunnel discharge flows from the tunnel through a series of settling ponds, once used for treatment, before discharging to the Dolores River. It should be noted that the discharge from the St. Louis Tunnel was previously covered under a permit held by the Rico Development Corporation. Due to the dissolution of the Rico Development Corporation and other circumstances in 1996, the operation and maintenance of the St. Louis Tunnel pond treatment system was abandoned and the expired permit was never renewed. Thus, the St. Louis Tunnel has been discharging mine drainage for the past 10 years with only passive settling of naturally precipitated metals as the flow passed through the pond system. An evaluation of existing in-stream water quality data shows that applicable water quality standards for the Dolores River are not being exceeded within Segment COSJDO03 except relative to the new cadmium standard. Herein the St. Louis Tunnel's current pond system will be referred to as the St. Louis Pond System, and the future treatment system will be referred to as the St. Louis Treatment System. Figure A-1 on the following page contains a map of the study area evaluated as part of this WQA.

The Dolores River from above the St. Louis Tunnel to below the Silver Swan Adit (approximately 2.5 river miles) has been studied extensively over the last 25 years by numerous entities and at different times. This includes an intense monitoring effort by Atlantic Richfield from 2000 forward, after it was recognized early in the WQA process that there were data gaps needing to be filled. Because of an inconsistent and disparate numbering system used in the identification of sampling locations by multiple entities, this WQA utilizes yet another numbering system as shown in Figure A-1 to enable the reader to better understand the various data. Specifically, this WQA uses the water body identification (WBID) number for each stream segment combined with the distance from the beginning of the stream segment. This numbering system is used to identify the ambient water quality sampling locations and the confluence locations of other discharges.

Information evaluated as part of this assessment includes data gathered from the Atlantic Richfield Company and its consultants, the Town of Rico, Department of the Interior, WQCD, Colorado Division of Water Resources (DWR), U.S. Environmental Protection Agency (EPA), U. S. Geological Survey (USGS), and the local water commissioner. The actual data used in the assessment consist of the best information available at the time of preparation of this WQA package.

Figure 1 - WQA Study Area



II. Water Quality

The St. Louis Tunnel discharges to the WBID stream segment COSJDO03, which means the San Juan River Basin, Dolores River Sub-basin, Stream Segment 03. This segment is composed of the "Mainstem of the Dolores River from a point immediately above the confluence with Horse Creek to a point immediately above the confluence with Bear Creek." Stream segment COSJDO03 is classified for Cold Water Aquatic Life Class 1, Class E Recreation, and Agriculture. The standards in Table A-2 will be assigned to stream segment COSJDO03 in accordance with the *Classifications and Numeric Standards for San Juan and Dolores River Basins*.

Note that revisions to the *Classifications and Numeric Standards for San Juan and Dolores River Basins* were adopted by the Water Quality Control Commission (WQCC) as of February 12, 2007 and became effective as of July 1, 2007. Included in the revisions were changes to the water quality standards for total recoverable arsenic, dissolved cadmium, and dissolved zinc. The revised water quality standards are incorporated into the calculations of potential effluent limits in this WQA.

Statewide Basic Standards have been developed in Section 31.11(2) and (3) of *The Basic Standards and Methodologies for Surface Water* to protect the waters of the state from radionuclides and organic chemicals. In Secdon 31.11(1) of the regulations, narrative standards are applied to any pollutant of concem, even where there is no numeric standard for that pollutant. Waters of the state shall be "free from harmful substances in harmfiil amounts." Total dissolved solids (TDS) and sediment are such pollutants of concem discussed by Agricultural and Water Quality Standards workgroups. In order to protect the Basic Standards in waters of the state, effluent limitations with monitoring, or "monitoring only" requirements for radionuclides, organics, TDS, or any parameter of concem could be put in CDPS discharge permits.

Numeric standards are developed on a basin-specific basis and are adopted for particular stream segments by the WQCC. To simplify the listing of the segment-specific standards, many of the aquatic life standards are contained in a table at the begimiing of each chapter of the regulations. Standards for metals are generally shown in the reguladons as Table Value Standards (TVS), and these often must be derived from equations that depend on the receiving stream hardness or species of fish present. The Classifications and Numeric Standards documents for each basin include a specification for appropriate hardness values to be used. Specifically, the regulations state that:

> "The hardness values used in calculating the appropriate metal standard should be based on the lower 95% confidence limit of the mean hardness value at the periodic low flow criteria as determined from a regression analysis of site-specific data. Where insufficient site-specific data exists to define the mean hardness value at the periodic low flow criteria, representative regional data shall be used to perform the regression analysis. Where a regression analysis is not appropriate, a site-specific method should be used."

Hardness data for the Dolores River downstream of the St. Louis Pond System discharge were sufficient to conduct a regression analysis using flow data from the USGS Gage Station 09165000 located approximately tive miles below the St. Louis Ponds discharge. A regression analysis (Figure 2) was conducted using flow data from the USGS Gage Station and hardness data from sampling location COSJDO03-1.4, which is located downstream of the pond system outfall. Flow data from the USGS Gage Station was used in the regression because it provided more paired data sets to conduct a regression analysis and because flow data from the USGS Gage Station correlated well with the flow data available for sampling location COSJDO03-1.4 (R^2 = 0.9460). Data were available for a period of record from October 1999 through August 2005. Fifteen paired flow and hardness data points were available, but three sets of paired data were excluded as they reflected hardness data collected at times of high flows (i.e., flows greater than 75 cfs). Because of the limited data for this location, the statistical signiticance of the R^2 = 0.6393 will need to be improved with additional data in the future when the data become available. The regression analysis was computed to a low flow of 6.9 cfs, which was the lowest of the measured flows in the data set. The 95th confidence interval of the hardness data was then calculated, resuiting in a hardness value equal to 247 mg/l. This hardness value and the formulas contained in the TVS were used to calculate the in-stream water quality standards for metals with the results shown in Table A-3.

Table A-2 **In-stream Standards for Stream Segment COSJDO03**
Physical and Biological
Dissolved Oxygen (DO) = 6 mg/l, minimum
Dissolved Oxygen (DO) = 7 mg/l, minimum (during spawning)
pH = 6.5 – 9.0 su
E. coli = 126 colonies/100 ml
Inorganic
Ammonia acute and chronic = TVS
Chlorine acute = 0.019 mg/l
Chlorine chronic = 0.011 mg/l
Free Cyanide acute = 0.005 mg/l
Sulfide chronic = 0.002 mg/l
Boron chronic = 0.75 mg/l
Nitrite = 0.05 mg/l
Metals
Total Recoverable Arsenic acute = 340 µg/l
Total Recoverable Arsenic chronic = 7.6 µg/l
Dissolved Cadmium acute and chronic = TVS
Total Recoverable Trivalent Chromium chronic = 100 µg/l
Dissolved Hexavalent Chromium acute = 16 µg/l
Dissolved Hexavalent Chromium chronic = 11 µg/l
Dissolved Copper acute and chronic = TVS
Total Recoverable iron chronic = 1000 µg/l
Dissolved Lead acute and chronic = TVS
Dissolved Manganese acute and chronic = TVS
Total Mercury chronic = 0.01 µg/l
Dissolved Nickel acute and chronic = TVS
Dissolved Selenium acute = 18.4 µg/l

Dissolved Selenium chronic = 4.6 µg/l
Dissolved Silver acute and chronic = TVS
Dissolved Zinc acute and chronic = TVS

Figure 2
Hardness Regression

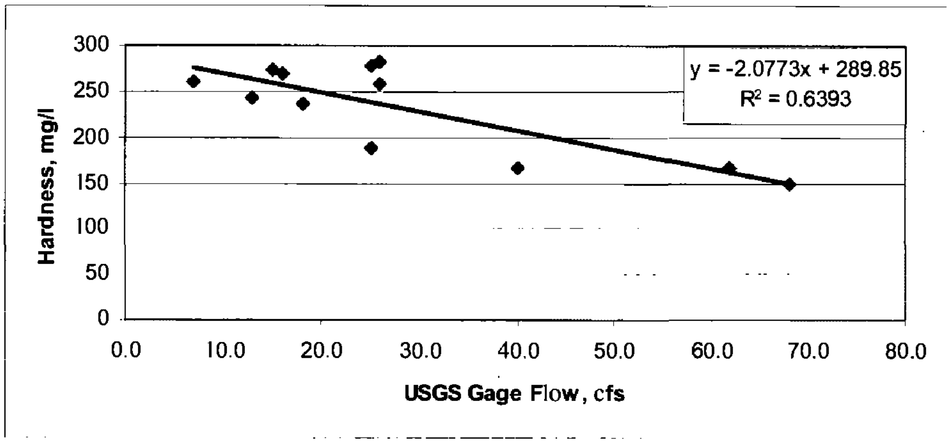


Table A-3

Water Quality Standards for Metals for Stream Segment COSJDO03
Based on the Table Value Standards Contained in the Colorado Department of Public Health and Environment Water Quality Control Commission *Regulation 34*

Calculated Using the Following Value for Hardness as $CaCO_3$:				247	mg/l
Parameter	***In-Stream Water Quality Standard***			***Formula Used***	
Cadmium, Dissolved	Acute	6.0	µg/l	$[1.136672-(\ln(hardness)*0.041838)]*[e^{(0.9151*(\ln(hardness))-3.1485)}]$	
	Chronic	0.84	µg/l	$[1.101672-(\ln(hardness)*0.041838)]*[e^{(0.7998(\ln(hardness))-4.4451)}]$	
Copper, Dissolved	Acute	32	µg/l	$e^{(0.9422(\ln(hardness))-1.7408)}$	
	Chronic	19	µg/l	$e^{(0.8545(\ln(hardness))-1.7428)}$	
Lead, Dissolved	Acute	170	µg/l	$[1.46203-0.145712\ln(hardness)][e^{(1.273(\ln(hardness))-1.46)}]$	
	Chronic	6.6	µg/l	$[1.46203-0.145712\ln(hardness)][e^{(1.273(\ln(hardness))-4.705)}]$	
Manganese, Dissolved	Acute	4035	µg/l	$e^{(0.3331(\ln(hardness))+6.4676)}$	
	Chronic	2229	µg/l	$e^{(0.3331(\ln(hardness))+5.8743)}$	
Nickel, Dissolved	Acute	1006	µg/l	$e^{(0.846(\ln(hardness))+2.253)}$	
	Chronic	112	µg/l	$e^{(0.846(\ln(hardness))+0.0554)}$	
Silver, Dissolved	Acute	9.6	µg/l	$\frac{1}{2}\, e^{(1.72(\ln(hardness))-6.52)}$	
	Chronic	1.50	µg/l	$e^{(1.72(\ln(hardness))-9.06)}$	
Zinc, Dissolved	Acute	310	µg/l	$0.978\, e^{(0.8525(\ln(hardness))+1.0617)}$	

	Chronic	269	µg/l	$0.986\,e^{(0.8525(\ln(hardness))+0.9109)}$

Ambient Water Quality

The WQCD evaluates ambient water quality based on a variety of statistical methods as prescribed in Secfions 31.8(2)(a)(i) and 31.8(2)(b)(i)(B) of *The Basic Standards and Methodologies for Surface Water, Regulation 31*. Ambient water quality is evaluated in this WQA for use in determining assimilative capacifies for pollutants of concem, and in conducting antidegradation reviews.

It is the general approach of the WQCD to use the most recent five years of data, if available, when determining ambient water quality. Where adequate data are not available in the five-year period, a greater time frame may be evaluated. Data used for this analysis primarily resulted from sampling collected by the WQCD and consultants for Atlantic Richfield. To conduct an assessment of the ambient water quality upstream of the St. Louis Pond System discharge, data were evaluated from sampling location COSJDO03-0.4. Ambient water quality data evaluated at this locafion include data collected during the period of record from April 1998 through January 2006. More than five years of data were used in order to provide a more robust data set and because there have been no changes in the watershed that would impact water quality.

It is the general approach of the WQCD to summarize ambient water quality data by the 15th, 50th, and 85th percentiles and the mean. When sample results are below detection levels, the value of zero is used in accordance with the WQCD's standard approach for summarization and averaging. These data are summarized in Table A-4.

Table A-4

Ambient Water Quality for Stream Segment COSJDO03-0.4 (µg/l)

Parameter	*Number of Samples*	*15th Percentile*	*50th Percentile*	*85th Percentile*	*Mean*	*Chronic Stream Standard*	*Notes*
As, Trec	4	0	0.3	0.655	0.325	7.6	
Cd, Dis	18	0	0	0.0675	0.189	0.8	
Cr+3, Trec	15	0	0	1.2	4.17	100	1
Cr+6, Dis	5	0	0	0.12	0.06	11	1
Cu, Dis	18	0	0.6	1.6175	1.10	19	
CN, Free	10	0	0	0	0	5	2
Fe, Trec	15	47.9	70	1027	417	1000	
Pb, Dis	18	0	0	0.2	0.106	6.6	
Mn, Dis	18	5.85	14	32.45	21.3	2229	
Hg, Tot	8	0.00002	0.0005	0.0012	0.0013	0.01	3
Ni, Dis	13	0	0	0.092	0.0746	112	
Se, Dis	14	0	0.5	0.7	0.457	4.6	
Ag, Dis	18	0	0	0.0315	0.025	1.5	
Zn, Dis	18	0	2.5	20	6.66	269	

Note 1: Data for total recoverable Cr+3 and dissolved Cr+6 were not available. Instead total recoverable chromium was used for the trivalent form and dissolved chromium was used for the hexavalent form.

Table A-4 Ambient Water Quality for Stream Segment COSJDO03-0.4 (µg/l)							
Parameter	***Number of Samples***	***15th Percentile***	***50th Percentile***	***85th Percentile***	***Mean***	***Chronic Stream Standard***	***Notes***
Note 2: The stream standard reflected herein is the acute stream standard. Because no free cyanide data were available, data reflecting total cyanide were used.							
Note 3: Mercury data is suspect due to contamination in the field blanks. Some of the data may be voided in accordance with Method 1631. See discussion on mercury analytical results below this table.							

The ambient and effluent total mercury samples collected since 2003 were analyzed using EPA Method 1631, which is able to measure low levels of total mercury. The method detection limit (MDL) for Method 1631 is 0.2 ng/l (0.0002 µg/l) and the practical quantitation level (PQL) is 0.5 ng/l (0.0005 µg/l). Due to the very low levels of detection, inadvertent and unavoidable sample contamination can have a significant impact on the total mercury measurement. For this reason, field blanks and method blanks are critical in determining the true concentration of total mercury in the sample. Following the procedure outlined in Method 1631 to void or adjust total mercury measurements based on contamination of field blanks, five of the eight ambient measurements can be considered invalid. The 50^{th} percentile of the remaining three valid ambient samples indicates that there was a non-detectable level of total mercury upstream of the discharge. However, due to the limited amount of data and to ensure water quality protecfion, the 50th percentile of the eight original samples was used to determine WQBELs. As noted later in this WQA, contamination of field blanks may also be an issue for the effluent total mercury data. Antidegradation limits were not calculated at this time for mercury, because the limits are so low that the issue of contaminafion needs to be addressed before appropriate limits can be established. More mercury data will be collected in the fiiture to correct the uncertainty with the Hg effluent levels and potential effluent limitations.

III. Water Quantity

The Colorado Regulations specify the use of low flow conditions when establishing water quality based effluent limitations, specifically the acute and chronic low flows. The acute low flow, referred to as 1E3, represents the one-day low flow recurring in a three-year interval. The chronic low flow, 7E3, represents the 7-day average low flow recurring in a three-year period. The chronic low flow, 30E3, represents the 30-day average low flow recurring in a three-year interval.

<u>Low Flow Analysis</u>

To best determine the low flows available in the receiving stream to the St. Louis Treatment System, a flow gage measurement immediately upstream of the discharge should be used. Because there were no flow gages immediately upstream of the current St. Louis Pond System outfall, flows measured at a downstream gage station were used to esfimate upstream flows.

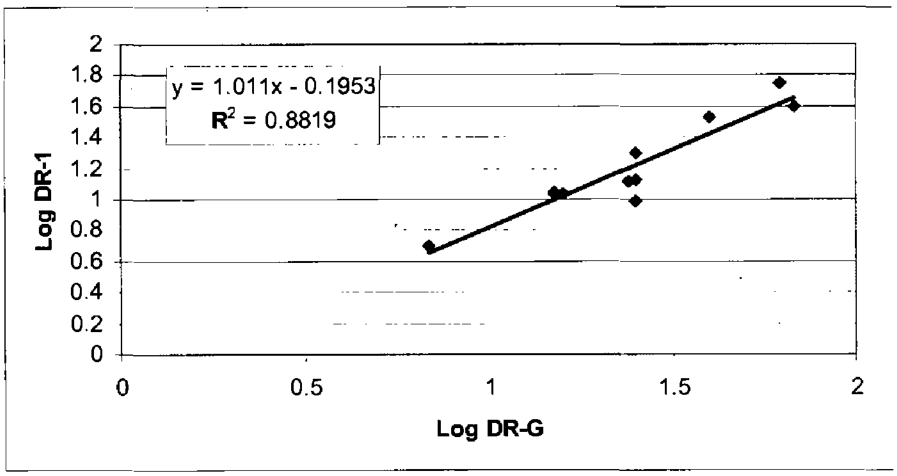
Daily flows from the USGS Gage Station 09165000 (Dolores River near Rico, CO) were obtained for the period of record of October 1, 1993 through September 30, 1996 and from October 1, 1998 through September 30, 2005. The gap in the USGS Gage Stafion flow data is due to the gage station not being in operation for the period of October 1, 1996 through

September 30, 1998. This gage station and these time frames were deemed the most accurate and representative of current flows and were therefore used in this analysis.

The 1E3 and 30E3 low flows were calculated using U.S. Environmental Protection Agency (EPA) DFLOW software. The output from DFLOW provides calculated acute and chronic low flows for each month. During the months of April, May, and June, the acute low flow calculated by DFLOW exceeded the chronic low flow. In accordance with Regulation 31.9(1) of the Basic Standards and Methodologies for Surface Water, transitional 30E3 low flows were calculated for these months based on the prescribed method of using a forward moving harmonic mean.

To estimate the low flows upstream of the St. Louis Treatment System discharge, a regression analysis (Figure 3) was performed using paired in-stream measured flow at sampling site COSJDO03-0.4 and daily flows measured by the USGS Gage Station 09165000. The equation for the line of best tit was used to convert the calculated low flows at the USGS Gage Station 09165000 to upstream low flows. In the future it will be best to use a lengthy record of actual stream flow measurements from above the discharge point, and this will be done once the data is available.

Figure 3
Stream Flow Regression Analysis



The period of record for paired stream flow data used in the regression analysis was within the same period of record used to calculate low flows at the USGS Gage Station. Note that sample dates were excluded from the regression analysis if there were not matching in-stream flows and USGS Gage Station flows. Additionally, data were excluded as non-representative if they were for high flows above 75 cfs. If a low flow regression has to used in future assessments, the statistical signiticance of the $R^2 = 0.8819$ will be improved with additional data when the data become available.

Based on the low flow analysis described, monthly upstream low flows above the St. Louis Treatment System were calculated and are presented in Table A-5.

Table A-5

Low Flows (cfs) for the Dolores River Upstream of the St. Louis Treatment System

Low Flow	*Annual*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
1E3 Acute	3.2	3.8	5.7	4.9	22	45	13	7.9	5.6	7.9	9.9	5.9	3.2
30E3 Chronic	6.1	6.1	6.1	6.2	23	45	13	8.5	7.9	7.9	11	6.1	6.1

The 7E3 low flow was calculated to be 4.0 cfs from the same data used to calculate the 1E3 and 30E3 low flows.

<u>Mixing Zone Considerations</u>

The mixing ratio is < 20:1 dilution. Therefore other mixing zone considerations will apply, and would be implemented through the permit. The other allowed exemptions from mixing zone constraints must be investigated according to the Colorado Mixing Zone Implementation Guidance. Any dilution reductions will be decided by the permittee and Division, after these investigations.

IV. Technical Analysis

In-stream background data and low flows evaluated in sections II and III are ultimately used to determine the assimilative capacity of the receiving waters below the St. Louis Treatment System discharge for pollutants of concern. The WQCD's normal approach is to conduct a technical analysis of stream assimilative capacity using the lowest of the monthly upstream low flows (referred to as the annual low flow) as calculated in the low flow analysis. However, because of high monthly variability in stream flows and discharge rates for the St. Louis Pond system, this WQA has been developed to consider separate monthly low flows. .

The WQCD's standard analysis consists of steady-state, mass-balance calculations for most pollutants and modeling for pollutants such as ammonia. The mass-balance equation is used by the WQCD to calculate the maximum allowable concentration of pollutants in the effluent, and accounts for the upstream concentration of a pollutant, critical low flow (minimal dilution), effluent flow, and the water quality standard. The mass-balance equation is expressed as:

$$M_2 = \frac{M_3Q_3 - M_1Q_1}{Q_2}$$

where:

Q_1 = Upstream low flow (1E3 or 30E3)
Q_2 = Average daily effluent flow (design capacity)
Q_3 = Downstream flow ($Q_1 + Q_2$)
M_1 = In-stream background (upstream) pollutant concentrations
M_2 = Calculated maximum allowable effluent pollutant concentration (a.k.a, the water quality-based effluent limitation (WQBEL))
M_3 = Maximum allowable in-stream pollutant concentration (water quality standards)

The upstream background pollutant concentrations (M_I) used in the mass-balance equation will vary based on the regulatory detinition of existing water quality. For dissolved metals, existing quality is determined to be the 85th percentile. For total and total recoverable metals, existing quality is determined to be the 50th percentile.

Pollutants to be Evaluated

As part of this WQA, cyanide and metals for which there are standards were evaluated. The pollutants evaluated thus included:

- Total recoverable arsenic (As, Trec)
- Dissolved cadmium (Cd, Dis)
- Total recoverable trivalent chromium (Cr^{+3}, Trec)
- Dissolved hexavalent chromium (Cr^{+6}, Dis)
- Dissolved copper (Cu, Dis)
- Free cyanide (CN, Free)
- Total recoverable iron (Fe, Trec)
- Dissolved lead (Pb, Dis)
- Dissolved manganese (Mn, Dis)
- Total mercury (Hg, Tot)
- Dissolved nickel (Ni, Dis)
- Dissolved selenium (Se, Dis)
- Dissolved silver (Ag, Dis)
- Dissolved zinc (Zn, Dis)
- Temperature
- Salinity

During the assessment of the St. Louis Pond System and receiving stream water quality, no additional parameters were identified as pollutants of concem.

St. Louis Tunnel

The St. Louis Tumel is located in the SE quarter of Section 25, T40N, R11W in Dolores County. The St. Louis Tumel is located upstream of the confluence with Silver Creek and the Town of Rico. The St. Louis Tunnel discharge is made up of surface water mine drainage emanating from the mountain, which is routed through a series of 11 settling ponds before discharging to the Dolores River. Flow rates for the discharge are dependent upon regional precipitation patterns and natural hydrogeologic processes and are not subject to manipulation. Based on records of historical discharge rates for the pond system, monthly effluent discharge flows ("design flows") were established as follows:

- January –2 cfs
- February – 2 cfs
- March – 2 cfs
- April – 2.5 cfs

- May – 3 cfs
- June – 3.3 cfs
- July – 3.2 cfs
- August – 3 cfs
- September – 3.1 cfs
- October – 2.5 cfs
- November – 2.2 cfs
- December – 2 cfs

Nearby Sources

There are tive unpermitted historic sources of ruetals to the Dolores River in the vicinity of the Town of Rico. These mine-related drainages include:

- The Argentine Seep, which discharges to Silver Creek upstream of the Town of Rico.
- The Columbia Tailings Seep, which discharges to the Dolores River downstream of the confluence with Silver Creek, south of the Town of Rico.
- The Rico Boy Adit, which discharges to a constructed wetland that drains to the Dolores River downstream of the Columbia Tailings Seep.
- The Santa Cruz Adit, which discharges to the same constructed wetland as the Rico Boy Adit.
- The Silver Swan Adit, which discharges to a constructed wetland that drains on an interruittent basis (frequently having no discharge) to the Dolores River downstream of the Rico Boy and Santa Cruz Adits.

These other potential pollutant sources were not included in this determination of the assimilative capacities because of the lack of information about the exact impact of these discharges have on COSJDO03. The flow rates for the other unpermitted discharges are small in comparison to the St. Louis Treatment System discharge and at certain times of the year these other sources do not discharge at all. In addition, the anticipated treatment of the St. Louis Tunnel discharge will result in lower pollutant levels in the stream, further improving the water quality conditions in the Dolores River. Therefore, it was concluded that a mass balance calculation at the St. Louis Treatment system discharge would be protective of the Dolores River until further analysis indicates otherwise.

An assessment of nearby facilities based on EPA's Permit Compliance System (PCS) database found no other permitted discharges on Segment 3 of the Dolores River and only three permitted dischargers in all of Dolores County. These were:

- COG582039, the Town of Dove Creek domestic Wastewater Treatment Plant (WWTP)
- COG582023, Lee, Richard domestic WWTP
- CO0045745, Lucas Property Holdings Gold Mine.

These facilities are located more than twenty miles downstream from the St. Louis Tumel and thus were not considered relevant to this assessment. There is also a potential new source to consider for a new domestic WWTF (PEL-200178). The Town of Rico is proposing a domestic WWTF that will discharge to the mainstem of the Dolores River just above the confluence of the Dolores River and Sulfur Creek. The affects of this discharge point should not add high metals to the stream because the town's domestic water source is located above the problematic mining areas. Any impacts from the proposed Town of Rico WWTF will need to be evaluated in the future if the WWTF is constmcted.

Metals and Cyanide

Metals are pollutants of concem in this assessment. At the request of Atlantic Richtield, monthly assimilative capacities for metals and cyanide were calculated for the St. Louis Treatment System discharge. Monthly assimilative capacities were calculated using the mass-balance equation provided in the beginning of Section IV. The data used in the mass-balance equation are summarized in the following tables:

- Table A-6 summarizes the chronic upstream low flows (Q_1), effluent design flows (Q_2), and combined downstream flows (Q_3) used to calculate the chronic monthly assimilative capacities.
- Table A-7 summarizes the acute upstream low flows (Q_1), effluent design flows (Q_2), and combined downstream flows (Q_3) used to calculate the acute monthly assimilative capacities.
- Table A-8 summarizes the upstream background concentrations (M_1) and the chronic and acute water quality standards (M_3) used to calculate chronic and acute monthly assimilative capacities.

The calculated chronic and acute monthly assimilative capacities shown in Tables A-9 and A-10, respectively, are the monthly maximum levels that could be discharged from the St. Louis Treatment System at the monthly design flows without exceeding water quality standards in Dolores River during low-flow conditions. This procedure is protective of water quality in the Dolores River because it accounts for monthly variation in both the St. Louis Tumel discharge and the in-stream low flow. The flow rates of both the St. Louis Tunnel discharge and the Dolores River are related to area precipitation, and therefore, it is highly unlikely the St. Louis Treatment System discharge will be at peak rates during low-flow river conditions. Because the St. Louis Tumel discharge flows are related to precipitation there is the possibility that the "design flows" established for this WQA may be exceeded. If this situation were to occur, the waste load allocations provided in Tables A-11 and A-12 would be applied to the discharge to be protective of the water quality standards.

Table A-6

Flow Calculations for Chronic Assimilative Capacities

Flow Type	***Month***											
	Jan	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
Monthly Low Flow Q_1 (cfs)	6.1	6.1	6.2	23.2	45.4	13.2	8.5	7.9	7.9	10.5	6.1	6.1
Effluent Flow Q_2 (cfs)	2	2	2	2.5	3	3.3	3.2	3	3.1	2.5	2.2	2
Combined Flow Q_3 (cfs)	8.1	8.1	8.2	25.7	48.4	16.5	11.7	10.9	11.0	13.0	8.3	8.1

Table A-7

Flow Calculations for Acute Assimilative Capacities

Flow Type	***Month***											
	Jan	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
Monthly Low Flow Q_1 (cfs)	3.8	5.7	4.9	21.9	45.4	12.5	7.9	5.6	7.9	9.9	5.9	3.2
Effluent Flow Q_2 (cfs)	2	2	2	2.5	3	3.3	3.2	3	3.1	2.5	2.2	2
Combined Flow Q_3 (cfs)	5.8	7.7	6.9	24.4	48.4	15.8	11.1	8.6	11.0	12.4	8.1	5.2

Table A-8
Background and Water Quality Standards for Chronic and Acute Assimilative Capacities

Pollutant	***Background Cone. M_1 (µg/l)***	***Chronic Water Quality Standard M_3 (pg/l)***	***Acute Water Quality Standard M_3 (µg/l)***
As, Tree	0.30	7.6	340
Cd, Dis	0.068	0.84	6
Cr+3, Tree	0	100	NA
Cr+6, Dis	0.12	11	16
Cu, Dis	1.6	19	32
CN, Free	0	NA	5
Fe, Tree	70	1,000	NA
Pb, Dis	0.20	6.6	170
Mn, Dis	32	2229	4035
Hg, Tot	0.0005	0.01	NA
Ni, Dis	0.092	112	1,006
Se, Dis	0.70	4.6	18.4
Ag, Dis	0.032	1.5	9.6
Zn, Dis	20	269	310

Table A-9
Chronic Assimilative Capacities for Metals and Cyanide for the St. Louis Treatment System (µg/l)

Pollutant	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
As, Tree	30	30	30	75	118	37	27	27	26	38	28	30
Cd, Dis	3.2	3.2	3.2	8.0	12.5	3.9	2.9	2.9	2.8	4.1	3.0	3.2
Cr+3, Tree	407	407	411	1,029	1,614	500	367	362	354	521	379	407
Cr+6, Dis	44.4	44.4	44.8	112	176	54.5	40.0	39.5	38.6	56.8	41.4	44.4
Cu, Dis	72.4	72.4	73.0	180	282	88.4	65.3	64.6	63.1	92.2	67.6	72.4
Fe, Tree	3,857	3,857	3,888	9.636	15.084	4.715	3,479	3,438	3,360	4,914	3.598	3,857
Pb, Dis	26.3	26.3	26.5	66.0	104	32.2	23.7	23.4	22.8	33.5	24.5	26.3
Mn, Dis	8,980	8,980	9,050	22,630	35,490	11,000	8,080	7,990	7,800	11,470	8,370	8,980
Hg, Tot	0.039	0.039	0.040	0.098	0.15	0.048	0.035	0.035	0.034	0.050	0.037	0.039

Ni, Dis	460	460	460	1150	1800	560	410	410	400	580	430	460
Se, Dis	16.6	16.6	16.7	40.8	63.7	20.2	15.0	14.8	14.5	21.0	15.5	16.6
Ag, Dis	6.01	6.01	6.06	15.1	23.7	7.37	5.41	5.35	5.23	7.68	5.60	6.01
Zn, Dis	1,030	1,030	1,040	2,580	4,040	1,260	930	920	900	1,320	960	1,030

Table A-10
Acute Assimilative Capacities for Metals and Cyanide for the St. Louis Treatment System (µg/l)

Pollutant	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
As, Tree	992	1,305	1,171	3,312	5,484	1,629	1,175	976	1,202	1,679	1,258	891
Cd, Dis	17.4	22.9	20.5	57.9	95.8	28.5	20.6	17.1	21.1	29.4	22.0	15.6
Cr+6, Dis	46.5	61.1	54.8	155	256	76.2	55.0	45.7	56.3	78.6	58.9	41.8
Cu, Dis	90.3	118	106	298	492	147	107	88.9	109	152	114	81.3
CN, Free	14.6	19.2	17.2	48.7	80.7	24.0	17.3	14.4	17.7	24.7	18.5	13.1
Pb, Dis	496	652	585	1656	2741	814	587	488	601	839	629	446
Mn, Dis	11,720	15,410	13,820	39,060	64,650	19,220	13,870	11,530	14,190	19,820	14,850	10,530
Ni, Dis	2,940	3,860	3,470	9,810	16,240	4,820	3,480	2,890	3,560	4,970	3,730	2,640
Se, Dis	52.4	68.7	61.7	173	286	85.5	61.9	51.5	63.3	88.2	66.2	47.1
Ag, Dis	28.0	36.8	33.0	93.3	155	45.9	33.1	27.5	33.9	47.3	35.5	25.1
Zn, Dis	870	1,130	1,020	2,850	4,700	1,410	1,020	850	1,050	1,450	1,090	780

Table A-11
Chronic Waste Load Allocations for Metals and Cyanide for the St. Louis Treatment System (lbs/d)

Pollutant	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
As, Tree	0.32	0.32	0.33	1.02	1.91	0.65	0.47	0.43	0.44	0.52	0.33	0.32
Cd, Dis	0.035	0.035	0.035	0.108	0.203	0.070	0.050	0.046	0.047	0.055	0.036	0.035
Cr+3, Tree	4.39	4.39	4.43	13.86	26.11	8.88	6.32	5.86	5.91	7.02	4.50	4.39
Cr+6, Dis	0.479	0.479	0.483	1.510	2.842	0.969	0.690	0.639	0.645	0.765	0.491	0.479
Cu, Dis	0.781	0.781	0.787	2.431	4.564	1.573	1.127	1.044	1.054	1.242	0.801	0.781
Fe, Tree	41.6	41.6	41.9	129.8	243.9	83.9	60.0	55.6	56.1	66.2	42.7	41.6
Pb, Dis	0.283	0.283	0.285	0.890	1.674	0.572	0.408	0.378	0.382	0.452	0.290	0.283
Mn, Dis	96.8	96.8	97.6	304.9	573.9	195.7	139.4	129.2	130.4	154.6	99.2	96.8
Hg, Tot	0.00042	0.00042	0.00043	0.0013	0.0025	0.00085	0.00061	0.00056	0.00057	0.00067	0.00043	0.00042
Ni, Dis	4.91	4.91	4.95	15.51	29.22	9.94	7.08	6.56	6.62	7.86	5.03	4.91
Se, Dis	0.179	0.179	0.180	0.550	1.029	0.359	0.259	0.240	0.242	0.283	0.184	0.179
Ag, Dis	0.0648	0.0648	0.0653	0.2040	0.3839	0.1310	0.0934	0.0865	0.0873	0.1035	0.0664	0.0648

Zn, Dis	11.15	11.15	11.24	34.78	65.33	22.48	16.09	14.91	15.05	17.75	11.44	11.15

Table A-12
Acute Waste Load Allocations for Metals and Cyanide for the St. Louis Treatment System (lbs/d)

Pollutant	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
As, Trec	10.7	14.1	12.6	44.6	88.7	29.0	20.3	15.8	20.1	22.6	14.9	9.61
Cd, Dis	0.187	0.246	0.221	0.780	1.550	0.507	0.355	0.277	0.352	0.396	0.261	0.168
Cr+6, Dis	0.501	0.659	0.591	2.088	4.147	1.356	0.949	0.739	0.941	1.059	0.699	0.450
Cu, Dis	0.973	1.276	1.146	4.013	7.958	2.619	1.840	1.437	1.823	2.045	1.353	0.877
CN, Free	0.1573	0.2070	0.1857	0.6569	1.3053	0.4263	0.2982	0.2322	0.2955	0.3330	0.2196	0.1414
Pb, Dis	5.34	7.03	6.31	22.31	44.33	14.48	10.13	7.89	10.04	11.31	7.46	4.80
Mn, Dis	126.3	166.1	149.0	526.3	1045.4	341.8	239.3	186.4	237.1	267.0	176.1	113.5
Ni, Dis	31.7	41.7	37.4	132.2	262.6	85.8	60.0	46.7	59.5	67.0	44.2	28.4
Se, Dis	0.564	0.740	0.665	2.335	4.632	1.521	1.068	0.833	1.058	1.188	0.786	0.508
Ag, Dis	0.301	0.397	0.356	1.257	2.498	0.816	0.571	0.445	0.566	0.638	0.421	0.271
Zn, Dis	9.34	12.22	10.99	38.37	76.03	25.08	17.64	13.79	17.48	19.58	12.97	8.42

Temperature:

The mass-balance equation was used to determine the assimilative capacity for temperature or the Maximum Weekly Effluent Temperature (MWET). The upstream Maximum Weekly Average Temperature (MWAT) for the Dolores River was determined from the limited data that was collected at the upstream sampling location COSJDO03-0.4. At this time, there are only 10 temperature data points, of which, only one was measured during the summer months of June, July, and August. This one value, measured on 8/2/2005, was the maximum of the data set and was used as the MWAT. Additional temperature data will be necessary to more appropriately calculate the MWET. The calculations of the annual 7E3 low flow (4.0 cfs) used the same flow information as that used in calculating the 1E3 and 30E3 low flows.

Using the mass-balance equation provided in the beginning of Section IV, the chronic low flows set out in Section III, the MWAT as discussed above, and the in-stream standards for temperature shown in Section II, assimilative capacity for temperature was calculated. The data used and the resulting calculations of the allowable discharge temperature are set forth below.

Table A-13
Water Quality Based Effluent Limits for Temperature (Degrees C)

Parameter	*Q_1 (cfs)*	*Q_2 (cfs)*	*Q_3 (cfs)*	*MWAT*	*Standard*	*MWET*
Temperature	**4.0**	**3.3**	**7.3**	**13.8**	**20**	**27.5**

Salinity:

To protect against salinity levels becoming too high in the Colorado River, Regulation No. 61

states for industrial sources "the no-salt discharge requirement, and the requisite demonstration that it is not practicable to prevent the discharge of all salt, may be waived in those cases where the salt load reaching the mainstem of the Colorado River is less than one ton per day or 350 tons per year, whichever is more appropriate. The Division may permit the discharge of salt upon a satisfactory demonstration by the permittee that it is not practicable to prevent the discharge of salt." Since much of the effluent is intercepted groundwater that may reach the stream anyway, a monitoring only requirement for TDS may be justitied, solely to establish what the salt loading is to the stream.

There is also a possibility that limitations for EC_w and Sodium Adsorption Ratio (SAR) might be applied as according to Water Quality Control Division Poticy 24. However, the limited Na effluent data indicate a low Na concentration. The low Na level along with the available Ca and Mg data indicate that the SAR of the effluent is low. The TDS level is also not exceedingly high, indicating that the EC_w is also probably low. Because of the limited data, it is recommended that monitoring of the effluent be continued for these parameters to justify these conclusions.

V. Antidegradation Review

As set out in *The Basic Standards and Methodologies for Surface Water*, Section 31.8(2)(b), an antidegradation analysis is required where new or increased water quahty impacts occur to undesignated, or "reviewable" waterbodies. According to the *Classifications and Numeric Standards for San Juan and Dolores River Basins*, stream segment COSJDO03 is "reviewable." Thus, an antidegradation review is required for this segment if new or increased impacts are found to occur.

The WQCD's Antidegradation Signiticance Determination for New or Increased Water Quality Impacts Procedural Guidance, Version 1.0, updated April 2002 (hereinafter referred to as the WQCD's Antidegradation Guidance), provides guidance on the determination of new or increased water quality impacts or signiticant degradation. Because the Dolores River is undesignated, an antidegradation review is required to determine if any new or increased impacts will result in signiticant degradation. Once an impact is identified, the impact must be evaluated for signiticance. There are four tests for the absence of signiticant degradation as outlined in Section 31.8 (3)(c):

- For bioaccumulative toxic pollutants such as mercury, the new or increased loading from the source under review is less than 10 percent of the existing total load to that portion of the segment impacted.
- For all other pollutants
  - The flow rate of the discharge is small enough that it will be diluted by at least 100:1 at low flow by water in the stream; or
  - Only a temporary change in water quality will result; or
  - The new effluent concentration will not cause an increase of more than 15 percent of the available increment over the base line.

These tests must be evaluated for each pollutant of concern. Because this assessment relates to the issuance of a CDPS permit, which will be effecfive for a period of 5 years, the impact is not considered temporary or short-term. Also, the dilution ratio of chronic low flow to design flow is not greater than 100:1 for this discharge. Therefore, the concentration test must be conducted to determine the discharge levels that would result in insignificant degradation for each pollutant of concern. An anfidegradation review would not be necessary for a pollutant if there is a determination of no new or increased water quality impact for that pollutant.

Consistent with current WQCD procedures, the Baseline Water Quality (BWQ) concentrations for pollutants of concern should be established so that it can be used as part of the anfidegradation review. BWQ is defined by the WQCD as the condition of the water quality as of September 30, 2000. Furthermore, the WQCD specifies that BWQ will include the influence of the discharger if it was in place on September 30, 2000. Accordingly, BWQ concentrations are determined by assessment of downstream water quality at a location reflecfing fully mixed conditions. This site is the COSJDO03-1.4 sampling location downstream of the pond system outfall. The BWQ for the parameters of concern are listed below in Table A-14.

Table A-14
Baseline Water Quality Concentrations for the Dolores River below the St. Louis Pond System

Pollutant	***BWQ (µg/l)***	***WQS (µg/l)***
As, Trec	0.4	7.6
Cd, Dis	***0.85***	0.84
Cr+6, Dis	0.05	11
Cr+3, Trec	0.54	100
Cu, Dis	1.24	19
CN, Free	0	5
Fe, Trec	250	1000
Pb, Dis	0.25	6.6
Mn, Dis	419	2229
Ni, Dis	0	112
Se, Dis	0.92	4.6
Ag, Dis	0	1.5
Zn, Dis	165	269

Note:
Bold and italic numbers indicate the BWQ exceed the WQS.

In order to establish the BWQ condition, the WQCD evaluates five years of ambient, downstream water quality data, if available, for the five years prior to September 30, 2000. Due to very limited data (four or less data points) available during the timeframe of September 30, 1995 through September 30, 2000, the overall period of record used to determine the BWQ is April 1998 through January 2006. The justification for using data later than September 30, 2000 is that there have been no water quality changes to the watershed nor have there been any changes to the discharge since before September 30, 2000. Using the period of record of April 1998 through January 2006, provided 14 additional data points and results in a more accurate analysis of the BWQ.

The pollutant concentrations used as the BWQ vary based on the regulatory detinition of existing ambient water quality. For most pollutants, including dissolved metals; existing quality is characterized by the 85th percentile. For metals in the total and total recoverable form, existing quality is characterized by the 50th percentile.

Note that when the calculated BWQ concentration exceeds the water quality standard there is no baseline available increment to protect. According to the WQCD Antidegradation Guidance, the antidegradation-based average concentration (ADBAC) cannot be calculated and antidegradation-based limits would not apply because the water quality is already degraded based on the BWQ. For dissolved cadmium, the BWQ exceeds the water quality standards, therefore antidegradation-based limits do not apply.

After BWQ concentrations have been determined for potential pollutants of concem, the antidegradation analysis continues for those pollutants showing new or increased impacts on the receiving stream. New or increased impacts are expected to result from this permit issuance because for some pollutants the calculated WQBELs are greater than previous limits. Because there is not a current permit for the St. Louis Tunnel discharge and thus no current permit limits, the regulations provide for determination of implicit limits based on historic discharges. Table A-15 summarizes the effluent discharge data from the St. Louis Pond System that was used to determine the implicit limits (data shown in column titled "Maximum" of Table A-15). The effluent discharge data are for a period of record of October 1999 through January 2006. This period of record was used to maximize the number of samples in the data set. As noted previously, there have not been any changes to the effluent that would impact the discharge water quality during this time period. A comparison of the implicit limits with the calculated WQBELs indicates there is an increased impact for all pollutants except dissolved cadmium and dissolved zinc. Thus, the antidegradation review procedure must continue for all other parameters to determine if the impacts are signiticant.

The ADBAC limit is a two-year rolling average limit, which means that while an ADBAC limit will remain the same throughout the life of a permit, the permittee will determine compliance each month with the ADBAC limit by averaging the two previous years of data.

ADBACs are calculated using the significant concentration threshold (SCT), which is the additional amount of pollutant above the BWQ that would not cause signiticant degradation. The baseline available increment (BAI) is the remaining assimilative capacity of the receiving stream below the discharge and is calculated as the water quality standard (WQS) minus the baseline water quality (BWQ). The SCT for most pollutants equals the BWQ plus 15 percent of the remaining assimilative capacity (15% of BAI), and is calculated by the following equation:

$$SCT = 0.15 \times (WQS\text{-}BWQ) + BWQ$$

The antidegradation requirements outlined in *Regulation 31.0Basic Standards and Methodologies for Surface Water* specify that chronic numeric standards and chronic low flows (30E3) be used; however, where there is only an acute standard, the acute standard and low flow (1E3) should be used. Chronic standards were available for all pollutants except cyanide. ADBACs are then determined by re-calculating the mass-balance equation using the SCT in place of the water quality standard, as in the following equation:

$$ADBAC = \frac{SCT \times Q_3 - M_1 Q_1}{Q_2}$$

where: Q_1 = Upstream low flow (1E3 or 30E3)
Q_2 = Average daily effluent flow (design capacity)
Q_3 = Downstream flow ($Q_1 + Q_2$)
M_1 = Ambient existing water quality concentration (From Section II)
SCT = Significant concentration threshold

The SCTs and ADBACs for pollutants of concern are provided in Table A-16.

Table A-15
Effluent Discharge Data for the St. Louis Pond System (µg/l)

Parameter	*Number of Samples*	*15th Percentile*	*50th Percentile*	*85th Percentile*	*Mean*	*Maximum*	*Notes*
As, Trec	4	0	0	0	0	0	
Cd, Dis	19	5.51	10	15.4	14.9	80.1	
Cr+3, Trec	15	0	0	0.19	0.153	1.6	
Cr+6, Dis	4	0	0	0	0	0	
Cu, Dis	19	0	3	8.17	3.24	15.7	
CN, Free	6	0	0	0	0	0	
Fe, Trec	20	302	500	1176	696	1410	
Pb, Dis	19	0	0	0.55	0.219	1.22	
Mn, Dis	19	955	1720	2128	1733	4210	
Hg, Tot	11	0	0	0.0003	0.0001	0.0004	1
Ni, Dis	14	0	0	0.5	1.43	10	
Se, Dis	13	0	0	0.58	0.284	1.39	
Ag, Dis	19	0	0	0.06	0.0268	0.27	
Zn, Dis	19	1320	2090	3098	2940	13,500	

Note 1: Four of the eleven total mercury samples are suspect due to contamination in the field blanks. These data could be voided in accordance with Method 1631. If data were to be voided, it would result in the seven remaining samples all being below the detection level. See discussion on total mercury in Section II. Water Quality.

Table A-16
SCTs and ADBACs for the St. Louis Treatment System

Pollutant	*BAI (µg/l)*	*SCT (µg/l)*	*M_1 (µg/l)*	*Q_1 (cfs)*	*Q_2 (cfs)*	*Q_3 (cfs)*	*ADBAC*
As, Trec	7.2	1.5	0.3	6.1	3.3	9.4	3.7
Cd, Dis	No BAI	No SCT	0.067	6.1	3.3	9.4	NA
Cr+6, Dis	11	1.69	0.12	6.1	3.3	9.4	4.6
Cr+3, Trec	99	15.5	0	6.1	3.3	9.4	44
Cu, Dis	17.8	3.9	1.62	6.1	3.3	9.4	8.1
CN, Free	5.0	0.750	0	3.2	3.3	6.5	1.5
Fe, Trec	750	363	70	6.1	3.3	9.4	903
Pb, Dis	6.4	1.2	0.20	6.1	3.3	9.4	3.0

Table A-16
SCTs and ADBACs for the St. Louis Treatment System

Pollutant	*BAI (µg/l)*	*SCT (µg/l)*	*M_1 (µg/l)*	*Q_1 (cfs)*	*Q_2 (cfs)*	*Q_3 (cfs)*	*ADBAC*
Mn, Dis	1810	691	32.5	6.1	3.3	9.4	1908
Ni, Dis	112	16.8	0.092	6.1	3.3	9.4	48
Se, Dis	3.68	1.47	0.70	6.1	3.3	9.4	2.9
Ag, Dis	1.5	0.225	0.0315	6.1	3.3	9.4	0.58
Zn, Dis	105	180	20	6.1	3.3	9.4	476

Notes:
- Cadmium BWQ exceeds the WQS so there is no BAI and thus the SCT and ADBAC cannot be calculated.
- Q_2 is based on the maximum of the monthly design flows.

In lieu of being subject to the ADBACs, facilities have the option of retaining their permit limits based on their current authorized load if those loads are protective of water quality standards. By agreeing to retain Non-Impact Limits (NIL) based on their current authorized load, new or increased impacts will not occur and thus ADBACs will not be considered in the permit. NILs are concentration limits based on the current permitted load and the proposed design flow.

For those pollutants for which permit limits have not yet been established, an implicit load allocation is determined and an implicit NIL is established. An implicit load allocation is based on the implicit limit (maximum concentration of the effluent in the previous 2 years of data) and the existing design flow. The implicit NIL is based on the implicit load allocation and the proposed design flow. However, the implicit NIL camot be greater in concentration than the implicit limit.

Although there is currently no effective permit for the St. Louis Tunnel, the previous permit contained limits for cadmium, copper, lead, silver, and zinc. The limits for these pollutants were based on the total recoverable forms, whereas the current water quality standards are based on the dissolved forms. Therefore, since no applicable prior effluent limits exist, implicit limits were established for both previously permitted pollutants and pollutants that were not previously permitted based on the maximum historic effluent concentrations. The period of record used for determining the implicit NILs is the same as that used in the antidegradation review. According to the WQCD Antidegradation Guidance the most recent 2-year period is to be used. However, some pollutants have limited data for this period and because this is an untreated mine drainage there have been no actions that would have resulted in changes in effluent quahty during the April 1998 through January 2006 timeframe.

The existing design flow used to calculate the implicit load allocation is the previously permitted discharge for the St. Louis Ponds of 4.0 cfs. The previously permitted discharge flow is higher than the proposed monthly design flows that were based on an evaluation of recorded historic discharge flows. This results in the calculated implicit NILs being higher in concentration than the implicit limits. As stated above, the implicit NIL cannot be greater in concentration than the implicit limit. Therefore, the implicit limits (or maximum concentration of the data) were used as the implicit NIL.

The implicit permitted load, the new WQBELs load, and the NIL were calculated using the following equations:

$$Implicit\ permitted\ load = M_{permitted} \times Q_{permitted} \times 8.34$$
$$New\ WQBELs\ load = M_2 \times Q_2 \times 8.34$$
$$NIL = M_{permitted}$$

where,

$M_{permitted}$ = Currcut permit limit or implicit permit limit (mg/l)
$Q_{permitted}$ = Design flow used in the current permit (MGD)
M_2 = Maximum allowable discharge concentration (WQBEL in mg/l)
Q_2 = Average daily effluent flow (design capacity in MGD)

When selecting the M_2, where both chronic and acute allowable discharge concentrations have been calculated, the most stringent was used.

For all pollutants evaluated, a summary of the implicit limits, the implicit permitted load, the new WQBELs, the new WQBEL load, ADBACs, and NILs are compared in Tables A-17.

Table A-17

WQBELs, ADBACs, and Non-Impact Limits Summary

Pollutant	*Implicit Limit (μg/l)*	*Implicit Load (lb/day)*	*WQBEL$_{new}$[1] (μg/l)*	*Load$_{new}$[1] (lb/day)*	*ADBAC (μg/l)*	*NIL (μg/l)*
As, Trec	0	0	21	0.38	3.7	0
Cd, Dis	80.1	0.855	2.3	0.04	NA[2]	80.1
Cr+6, Dis	0	0	31.1	0.55	4.6	0
Cr+3, TR	1.6	0.0171	285	5.07	44	1.6
Cu, Dis	15.7	0.168	51.1	0.91	8.1	15.7
CN, Free	0	0	9.8	0.18	1.5	0
Fe, Trec	1410	15	2719	48.36	903	1410
Pb, Dis	1.22	0.013	18.4	0.33	3.0	1.22
Mn, Dis	4210	44.9	6289	111.87	1908	4210
Ni, Dis	10	0.107	319	5.67	48	10
Se, Dis	1.39	0.0148	11.8	0.21	2.9	1.39
Ag, Dis	0.270	0.00288	4.2	0.07	0.58	0.27
Zn, Dis	13500	144	729	12.97	476	13500

Notes:
(1) For comparison purposes, WQBELs based on the annual low flow and the maximum design capacity were used and the new loads were calculated using the new WQBELs and the maximum of the monthly design flows.
(2) The ADBAC for Cadmium is not applicable (NA) because the BWQ exceeded the WQS so there is no BAI and thus the SCT and ADBAC cannot be calculated.

As noted in Table A-15, ADBACs and NILs are not applicable when the new WQBEL load is less than the implicit permitted load, or when the new WQBELs are less than the ADBACs. For cadmium and zinc the implicit load is greater than the new load, therefore, the ADBACs and NILs do not apply. For the pollutants for which ADBACs and NILs apply, if the facility chooses the NIL as the proposed 30-day average permit limit, ADBACs will not be applied. Additionally, the facility may complete an alternatives analysis, which could also result in ADBACs not being applied. These options can be further explored with the WQCD.

Antidegradation limits for total mercury were not calculated at this time due to the sample contamination issues associated with the low-level analytical methodology as discussed in Section II Water Quality. At this time, additional monitoring is needed to evaluate the contamination issues and to ascertain accurate levels of total mercury upstream of the discharge.

VI. References

Classifications and Numeric Standards for San Juan and Dolores River Basins, Regulation No. 34, CDPHE, WQCC, Effective July 1, 2007.

The Basic Standards and Methodologies for Surface Water, Regudation 31, CDPHE, WQCC, Effective May 31, 2008.

*Antidegradation Significance Determination for New or Increased Discharges, Procedural Guidance, Version 1.0, CD*PHE, WQCD, December, 2001.

Colorado Mixing Zone Implementation Guidance, CDPHE, WQCD, April 2002.

Colorado River Salinity Standards, *Regulation 39*, CDPHE, WQCC (last update effective 8/30/97)

Policy for Conducting Assessments for Implementation of Temperature Standards in Discharge Permits, Colorado Department Public Health and Environment, Water Quality Control Division Policy Number WQP-23, effective July 3, 2008.

Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops, Colorado Department Public Health and Environment, Water Quality Control Division Policy Number WQP-24, effective March 10, 2008.

Summary of Surface Water and Groundwater Data for Rico, Colorado, PTI Environmental Services, November 1995.

Rico Site Remediation Project, Surface Water Monitoring Program, Post-VCUP Interim Report, ESA Consultants, Inc., October 1997.

Upper Dolores River and Silver Creek Basin Water Quality and Discharge Monitoring Summary, ESA Consultants, Inc., December, 1999.

Upper Dolores River and Silver Creek Basin Water Quality and Discharge Monitoring Summary, ESA Consultants, Inc., September 18, 2000.

Emergency Response Trip Report, Rico Town Pond Site, USEPA Region VIII Superfund Technical Assessment and Response Team, Contract No. 68-W5-0031, TDD No. 0004-0010, May 5, 2000.

Emergency Response Trip Report, Rico Town Pond Site, USEPA Region VIII Superfund Technical Assessment and Response Team, Contract No. 68-W5-0031, TDD No. 9511-0015, June 19, 1996.

Attachment 2

Attachment 2

Removal Action Work Plan
Rico-Argentine Site – Rico Tunnels OU1

SITE GEOLOGY AND GROUNDWATER HYDROLOGY/QUALITY

1.0 Geology

The geology of the proposed water treatment system and treatment solids facilities at the Rico-Argentine Site (Site), Rico Tunnels OU01 is described in the following subsections. Figures A2-1A through A2-1D illustrate the distribution of bedrock, surficial deposits, and geologic structure in plan and section. This mapping is based on available published geologic mapping, review of color aerial photographs of the area, reconnaissance mapping, compilation of previous and recent subsurface exploration (including boring and test pit logs), and review of relevant geotechnical testing data on samples from the field investigations. Logs of the borings and test pits and the results of geotechnical testing relevant to this study are included in Appendix A.

1.1 Bedrock

The bedrock underlying the proposed water treatment system and treatment solids facilities is comprised mainly of the Middle Pennsylvanian-age (240-250 million years old) Lower Member of the Hermosa Formation and local volcanic intrusions of Late Cretaceous to Lower Tertiary-age (about 65 million years old) hornblende latite porphyry. The Hermosa rocks are generally described as follows:

> *"greenish-gray buff-weathering micaceous sandstone, siltstone, and arkose, locally conglomeratic, black and gray shale, and minor dark-gray limestone or dolomite; sandstone and arkose massively bedded or crossbedded, siltstone and shale thin bedded and slabby"* (Pratt, et al., 1969)

The estimated total thickness of this unit in the region is greater than 880 feet. Although only locally exposed in the slope above the ponds system to the east, some additional information on the nature of the Hermosa is available from geologic logs of the St. Louis Tunnel (McKnight, 1974). These logs show the presence of several intervals of younger hornblende latite porphyry that has intruded the older Hermosa sedimentary rocks. Areas of outcropping latite porphyry are locally present on the lower slope of CHC Hill to the east (see Figures A2-1B and A2-1C). The hornblende latite porphyry is described as follows:

> *"Abundant white plagioclase crystals in altered groundmass which ranges from light to dark gray, greenish gray, or brownish gray, depending on abundance of chlorite and iron oxides as alteration products. Forms sills and small laccoliths a few feet to several hundred feet thick and dikes a few feet to several tens of feet wide, throughout the Rico Mountains."* (Pratt, et al., 1969)

The bedrock in the vicinity is only of indirect significance to the proposed siting and design of the water treatment system and treatment system facilities, being the primary source of the generally thick cover of talus/slopewash (or colluvial) soils in the lower slopes to the east of and underlying the eastern portions of the area, and a minor contributor to the generally shallower alluvial deposits. As shown on Figures A2-1B and A2-1C, the only surface exposures of bedrock near the water treatment and solids facilities are about 300 feet upslope; bedrock crops out or is only shallowly buried in the slopes above the lower portion of the ponds system (including at the groundwater choke point discussed below). The St. Louis tunnel geologic logs noted previously suggest that bedrock may be as deep as about 250-300 feet into CHC Hill along the tunnel alignment (see Figure A2-1D). The only boring in the St. Louis Tunnel and ponds area that reportedly encountered bedrock (weathered sandstone) was B-5 at a depth of 29.5 feet.

1.2 Structure

The Rico area lies at the center of a geologically young structural uplift that occurred about 65 million years ago during a period of widespread crustal deformation known as the Laramide Orogeny. A structural dome about 10 miles across and with a vertical relief of over a mile formed centered over the Silver Creek area. This is evidenced by the exposure of very old bedrock (greenstone) in the lower hill slopes on both sides of the Dolores River in the vicinity of the Highway 145 bridge. Development of this dome was accompanied by extensive faulting that variably offset and fractured all the older major bedrock units, including the Lower Member of the Hermosa Formation. It was during this time that the hornblende latite porphyry intruded the fractured Hermosa rocks.

A much more recent episode of structural and hydrothermal activity occurred in the Rico area about 3-5 million years ago. During this time many of the older bedrock faults were reactivated and ore-bearing hydrothermal fluids moved into the fractured rock, locally resulting in the rich mineralization that characterized the historic Pioneer District.

This history of structural deformation has resulted in the present bedrock structure in the vicinity. The major structural features are the shallow (about 5-15°) bedding dips to the west-southwest in the Hermosa Formation, and a series of small to large bedrock faults ranging from a few feet to over 2000 feet of offset. The closest larger bedrock faults are the east-west trending Nellie Bly Fault that lies beneath the southern portion of the ponds system, and the northeast trending Princeton Fault crossing CHC Hill about 1500 feet southeast of the St. Louis Tunnel. Neither of these, or any of the numerous smaller bedrock faults in the vicinity are active (i.e., capable of generating earthquakes) and thus are of no particular consequence to the design of water treatment system or solids facilities.

1.3 Unconsolidated Natural Deposits.

Unconsolidated deposits at and in the immediate vicinity of the proposed water treatment system and treatment solids facilities include talus/slopewash (colluvium), alluvium, various mining/processing related waste materials, and fill. Subsurface information on these deposits was derived primarily from previous site investigations by Dames and Moore (1981), Colorado Department of Public Health and Environment (CDPHE, 2003), and more recent investigations by SEH and Anderson Engineering (see Appendix A for data from all of these investigations).

Talus/Slopewash. Talus/slopewash (colluvial) deposits are extensive and deep on most of the lower mountain slopes in the Rico area, including on CHC Hill at the St. Louis Tunnel and ponds system. These deposits were formed by weathering and local gravity movement of the typically fractured and locally altered bedrock previously described. Penetration of these deposits at various locations by mine workings (including on CHC Hill) indicates layers of variable horizontal thickness up to several hundred feet. The colluvium is typically comprised of a wide range of grain sizes from fines (silt/clay) to very large boulders. Crude sorting tends to occur as the colluvial deposits have accumulated by local gravity movement over recent geologic time.

Alluvium. Alluvial deposits are present underlying the relatively flat-bottomed Dolores River valley. Where partially penetrated by borings and where visible in the current river channel, the alluvium is typically comprised of sand and gravel with abundant cobbles and even some boulders present locally. Given the geologic/geomorphic environment in which these deposits formed, it is very likely that a wide range of grain sizes are locally present within the overall alluvial deposits. These deposits likely range from relatively fine-grained overbank sandy silts/clays to the very coarse channel deposits visible in the active river channel, with lenses of predominantly sand also to be expected. The coarser-grained materials tend to be rounded to subrounded and generally hard and strong as a result of having survived transport from upstream by the inferred much higher energy Dolores River flows in the late Quaternary. The maximum depth of alluvium penetrated by the borings to date is 13 feet in GW4. Although the total depth of alluvium is not known, it is estimated as on the order of 30-40 feet based on the geomorphology of the river valley and experience at other similar sites in the central/northern Rocky Mountains.

Landslides. As shown in part on Figure A2-1B, a major landslide is mapped by McKnight (1974) on the hill slope just to the north of the planned water treatment system facilities, and underlying and immediately upslope of the potential North Stacked Repository site. This feature is believed to have developed in talus/slopewash (colluvium) and/or weathered sedimentary bedrock on the lower slopes of CHC Hill. Based on observations in historic mine workings in CHC Hill, Ransome (1901) concluded that the slide debris was up to several hundred feet thick. It is possible, if not likely, that this landslide initially formed during a wetter climatic period in the Quaternary (during the last few tens of thousands of years). Erosional undercutting at the base of CHC Hill by a much larger Dolores River flow than at present could have triggered the sliding. Potential borrow areas along the base of the slopes north of the repository will need to be utilized with caution to avoid locally re-activating this landslide debris. The North Stacked Repository, if constructed, would act as a stabilizing buttress for a portion of the toe of this old slide mass.

Avalanches. There are several historically active avalanche chutes on the lower slopes of CHC Hill (and the adjoining NB Hill to the south) adjacent to and just south of the proposed water treatment system and solids facilities. The only potential impact to the proposed facilities from activation of any of these known avalanches would be temporary blocking during the winter of access to the facilities on the gravel road from Highway 145. Appropriate safety and maintenance measures would be implemented to maintain access for system operations during the winter months.

1.4 Artificial Fill and Mining/Mineral Processing Wastes

Artificial Fill. Relatively minor amounts of placed (but not necessarily engineered or controlled) fill are present at and in the vicinity of the water treatment system and treatment solids facilities. These include remnants of sidehill fill along the now abandoned RGS railroad alignment at the base of CHC Hill and embankments impounding the various existing ponds.

The Rio Grande Southern Railroad (RGS) mainline followed the lowermost slopes of CHC Hill north of Rico on a cut/fill alignment located above the historic floodplain of the Dolores River along the east boundary of the ponds (McCoy, et al., 1996). The portal of the St. Louis Tunnel is located immediately beneath the abandoned RGS mainline alignment.

Although not readily apparent from surface observations, it is likely that at least remnants of the original railroad fill and ballast are present along the alignment. The fill would almost certainly have been derived from local grading of the underlying natural talus/slopewash (colluvium) at the site, and thus be indistinguishable from that parent material. The rails, ties and any high-quality ballast have long since been removed.

Mining/Mineral Processing Wastes. The planned water treatment system and treatment solids facilities are located where historic mining and ore processing activities that occurred sporadically over a period of approximately 80 years. Deposits of waste rock, calcine tailings, spent ore material, and mining/processing related debris are locally present as a result of these mining/processing operations.

Waste rock from the original driving of the St. Louis Tunnel was disposed of locally in the immediate vicinity of the tunnel portal. The currently visible waste rock dump is an arcuate, sidehill deposit approximately 900 feet long, up to 250 feet wide, and up to an estimated 20-30 feet thick.

"Calcine" tailings resulting from sulfuric acid production (derived from roasting pyrite ore/tailings to high temperatures short of melting) were placed in Ponds 15-19 (HRI, 1979). Based on available borings and soundings, these fine- to very fine-grained silty sand tailings deposits are variable in thickness up to at least 22-23 feet. The Pond 16/17 area is also underlain by calcine tailings and Pond 15 has a small layer of calcine tailings beneath the existing settled treatment solids and sediments present from prior water treatment operations.

In the 1980s and 1990s, various reclamation activities decommissioned mining and mineral processing facilities and reclaimed the site.

2.0 Groundwater Hydrology

2.1 Conceptual Groundwater Flow Model

The general groundwater flow system in the area of the water treatment system and treatment solids facilities is illustrated on Figures A2-2 and A2-3. The following key features of the groundwater system are known or interpreted to exist.

- ***General ground water system*** - The bulk of groundwater flow through the area is dominated by the interactions of the Dolores River with groundwater in the local, essentially isolated alluvial (sand and gravel) aquifer underlying the site area in the locally wider valley reach. This interaction is characterized by: 1) recharge from the river at the upstream portion of the local alluvial aquifer where it becomes wider and thicker; and 2) ground water discharge to the river where the aquifer becomes narrower and thinner. This river/groundwater interaction is supplemented by natural groundwater flows from the hills to the east and west along with St. Louis Tunnel flows, ponds system seepage, and very minor flows of artesian geothermal water from abandoned mineral exploration drill holes. The Dolores River acts as a ground water discharge boundary in general, but is also a recharge boundary during high flows and at the head of valley segments.
- ***Net loss of water from ponds*** - The existing upper ponds have water levels above the river and are known to exhibit a net seepage loss of water, based on differences in surface water flow measurements at the tunnel and the ponds system discharge. The net loss is believed to be somewhat constant at about 0.4-0.6 cfs but is likely decreasing over time. This seepage discharges to the underlying shallow alluvial

aquifer and then to the Dolores River as described below. Some natural groundwater from the hills immediately east of the ponds system is also inferred to enter the underlying alluvial aquifer, flow under the existing ponds, and then discharge to the river adjacent to and just downstream of the ponds.

- ***Exploratory drill hole contribution*** - At least three leaking, abandoned deep mineral exploration drill holes are a source of natural artesian geothermal groundwater discharging as very minor surface flows to one or more of the lower ponds above the ponds system discharge at Pond 5.
- ***Groundwater "chokepoint"*** - Based on known site geology, most of the groundwater flow beneath the water treatment system and treatment solids facilities (which includes tunnel, pond and natural groundwater contributions) re-emerges as surface water due to a bedrock chokepoint where the valley-side alluvial aquifer pinches out (see Figure A2-2). This chokepoint occurs at a narrow breach in highly erosion-resistant greenstone bedrock that is just downstream of the ponds (see Figure A2-1B). At this location the valley narrows considerably and the only remaining alluvial deposits are the relatively narrow and shallow channel bed deposits. This results in a much smaller cross-sectional area of alluvial aquifer which forces alluvial groundwater to discharge to the river at or above the chokepoint. This condition is confirmed through flow measurements made at low flows both above and below the ponds which show a significant gain in river flow (on the order of 2 to 3 cfs in excess of that discharged from the ponds system). The chokepoint provides an appropriate sampling point to track the long-term effects of these groundwater discharges to the Dolores River.

2.2 Groundwater Aquifers

The only aquifer underlying the area is the alluvial/colluvial unit on the overbank of the Dolores River. Based on available boring logs and site observations, this aquifer unit is comprised of moderately to very dense, fine to coarse gravel with sand (and locally with clay lenses and layers) estimated at up to 30-40 feet thick. No in-well or aquifer pumping tests have been performed in this unit to date. The permeability of this unit is estimated as averaging on the order of 10^{-2} cm/sec for predominantly sandy alluvium to on the order of 10^{2} cm/sec for gravel-cobble channel deposits based on the apparent gradations of the soils comprising the unit and experience with similar aquifers in geohydrologically comparable settings. The Hermosa Formation underlying the alluvial/colluvial unit is inferred to act as an effective aquitard or aquiclude.

2.3 Groundwater Quality

Groundwater underlying the area of the water treatment system and treatment solid facilities has been investigated and exhibits varying quality both temporally and spatially. This situation exists due to a variety of conditions including buried mine wastes (waste rock, calcine and possibly other tailings and pond solids), presence of discharging geothermal waters from abandoned deep mineral exploration wells, potential seepage from the area of the collapsed reach of the St. Louis Tunnel adit (that is not intercepted ahead of the ponds system), recharge from the adjoining heavily mineralized hillside, seepage from the existing ponds, variability of the alluvial aquifer permeability, and seasonal fluctuations in groundwater.

Despite local areas of variable contamination, the groundwater discharged to the Dolores River is believed, on average, to meet surface water discharge standards. In addition, the very large majority of flow in the local aquifer beneath the site discharges to the Dolores River at the lower end of the ponds system. Because the groundwater surfaces as it leaves the shallow aquifer at the choke point, the local on-site groundwater is not believed to impact downstream groundwater quality.

2.4 Potential Impacts to Downstream Groundwater and Surface Water

To assess the potential impact of seepage from the existing ponds on water quality within the Dolores River immediately adjacent to the ponds system, a mass balance of loading was completed based on measurements made during low river flow conditions. Samples were collected above the ponds system and immediately above the ponds system discharge. Measurements of river flow were made at those same locations. The results of mass balance calculations showed that on average the metals with typically elevated concentrations in the tunnel discharge and untreated pond water (i.e., zinc, cadmium and iron) showed no measurable increase within the Dolores River alongside the ponds system. A measurable increase in manganese was noted in the same reach of the river.

As a further basis of investigating if the site was adversely impacting surface water quality downstream of the treatment ponds, a mass balance of loading and flow from above the entire ponds system to below the site at the chokepoint was completed. This analysis involved calculating instream loading based on flow measurements and metals concentration from sampling completed at low flows. Results from a total of eight sampling events over a five-year period were utilized. These events represented all occasions where the river flow was below 15 cfs at the upstream sampling location. Results of the analysis suggest an increase in surface water flow of between two (2) and three (3) cfs due to discharge of groundwater to the Dolores River from the isolated shallow alluvial aquifers on both sides of the river. The average calculated concentration of the groundwater discharged to the river would meet surface water standards for all parameters reviewed (cadmium, zinc, iron, and manganese). Although the results of metals analysis from several of the monitoring wells on-site showed existing groundwater to have locally high metals concentrations, the mass balance review shows that overall impacts of groundwater discharged to the surface water in this reach are not adverse.

2.5 References

CDPHE, 2003. Colorado Department of Public Health and Environment (CDPHE), Targeted Brownfields Assessment, Analytical Results Report and Appendix C - Data Validation Report, North Rico Light Industrial Park and County Maintenance Barn Sites, Rico, Colorado. April.

Dames and Moore, 1981. Report, Geotechnical and Hydrologic Investigations, St. Louis Adit Site, Silver Creek Tailings Site, Silver Creek Pipeline Route, Rico, Colorado, for Anaconda Copper Company. Golden, Colorado. August 28.

ESA Consultants Inc. (ESA), 1995. Rico Mining Area, Summary of Environmental Data, ARCO Records, Rico Development Corporation Records, Rico Properties Records. Prepared for Atlantic Richfield Company, Denver, Colorado. April 27.

Hazen Research, Inc. (HRI), 1973. Review of Test Leaching Project and Notes on Mineral Exploration Potential at Rico, Colorado. Prepared for Crystal Oil Company, Louisiana.

McCoy, Dell A., Coleman, Russ, and William A. Graves, 1996. The RGS Story, Volume V, Rico and the Mines. Sundance Publications, Ltd. Denver, Colorado.

McKnight, Edwin T., 1974. Geology and Ore Deposits of the Rico District, Colorado; US Geological Survey Professional Paper 723.

Pratt, Walden P., Edwin T. McKnight and Rene` A. DeHon, 1969. Geologic Map of the Rico Quadrangle, Dolores and Montezuma Counties, Colorado; GQ-797; U.S. Geological Survey.

Ransome, F.L., 1901. The Ore Deposits of the Rico Mountains, Colorado; U.S. Geological Survey Annual Report, 22nd, Part 2: 229-398.

WELLS / BORINGS

- DH-1 (ANDERSON ENGINEERING/SEH, 2008)
- EW-1, EB-1 (SEH, 2004)
- GW1 (CDPHE, 2003)
- B-1 (DAMES AND MOORE, 1981)
- EH-1 (ANACONDA MINERALS)
- DOMESTIC WELL

TEST PITS

- TP-1 (ANDERSON ENGINEERING/SEH, 2008)
- TP-2004A (SEH, 2004)
- TP-A (SEH, 2001)
- APB-1 (ANDERSON ENGINEERING, 1996)

GEOLOGIC UNITS

e	EMBANKMENT FILL, RIPRAP
f	ROAD FILL, PAVEMENT
wr	WASTE ROCK
ct	CALCINE TAILINGS
so	SPENT ORE
f/mw/d	MISCELLANEOUS FILL, MINE WASTE (TAILINGS, WASTE ROCK, ORE), BURIED DEMOLITION DEBRIS
Q_{al}	ALLUVIUM
Q_f	FAN DEPOSITS
Q_{tw}	TALUS, SLOPEWASH (COLLUVIUM)
Q_l	LANDSLIDE DEBRIS
TK_{lp}	LATITE PORPHYRY INTRUSIVES
P_{cu}	CUTLER FORMATION - SILTSTONE, ARKOSE AND CONGLOMERATE
P_{hl}	HERMOSA FORMATION (LOWER MEMBER) - SANDSTONE, SILTSTONE, SHALE, MINOR LIMESTONE OR DOLOMITE
P_l	QUARTZITE
M_l	LEADVILLE LIMESTONE
md	METADIORITE
g	GREENSTONE

SYMBOLS

GEOLOGIC CONTACT

D U BEDROCK FAULT; D * DOWN-THROWN SIDE, U * UP-THROWN SIDE

12 STRIKE AND DIP OF BEDDING

65 TREND AND PLUNGE OF FOLIATION

AECOM

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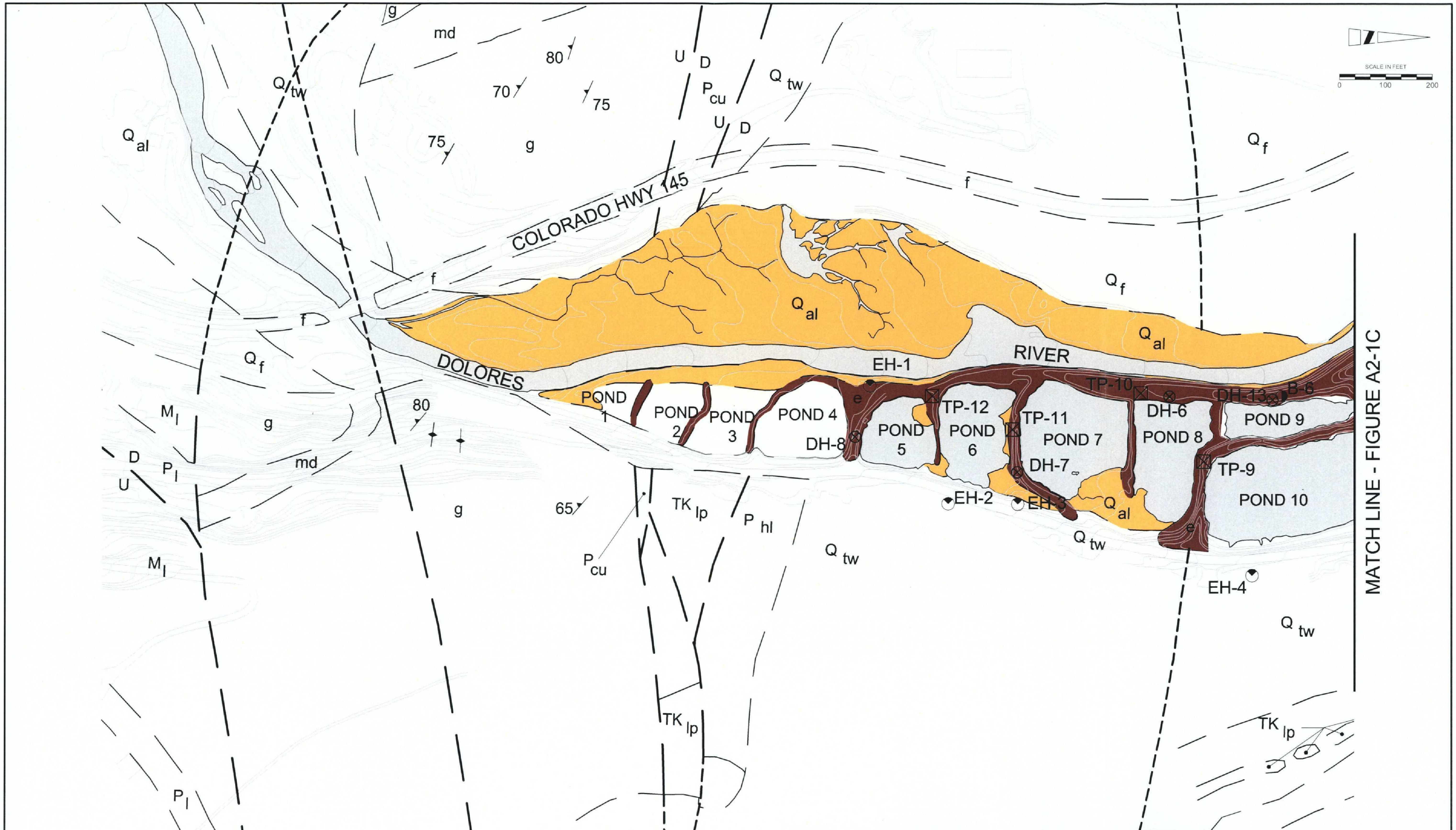
RICO-ARGENTINE SITE - OU01
REMOVAL ACTION WORK PLAN

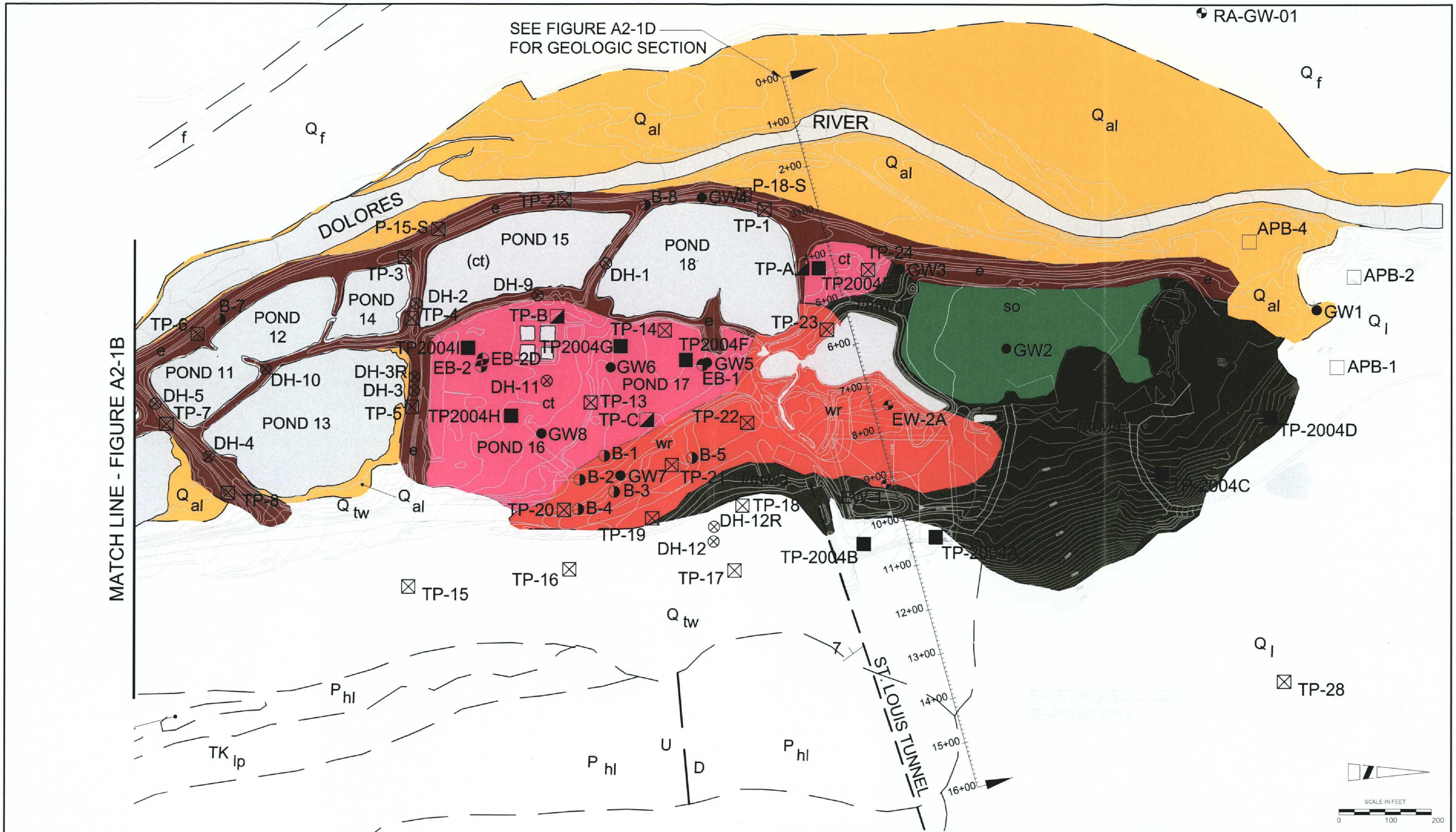
GEOLOGIC LEGEND

AECOM PROJECT NO. 60157757

FIGURE A2-1A



AECOM AECOM Technical Services, Inc. 717 17th ST., SUITE 2600 DENVER, COLORADO 80202 T 303.228.3000 F 303.228.3001 www.aecom.com	RICO-ARGENTINE SITE - OU01 REMOVAL ACTION WORK PLAN	AECOM PROJECT NO.	FIGURE
	GEOLOGIC MAP SHEET 1 OF 2	60157757	A2-1B



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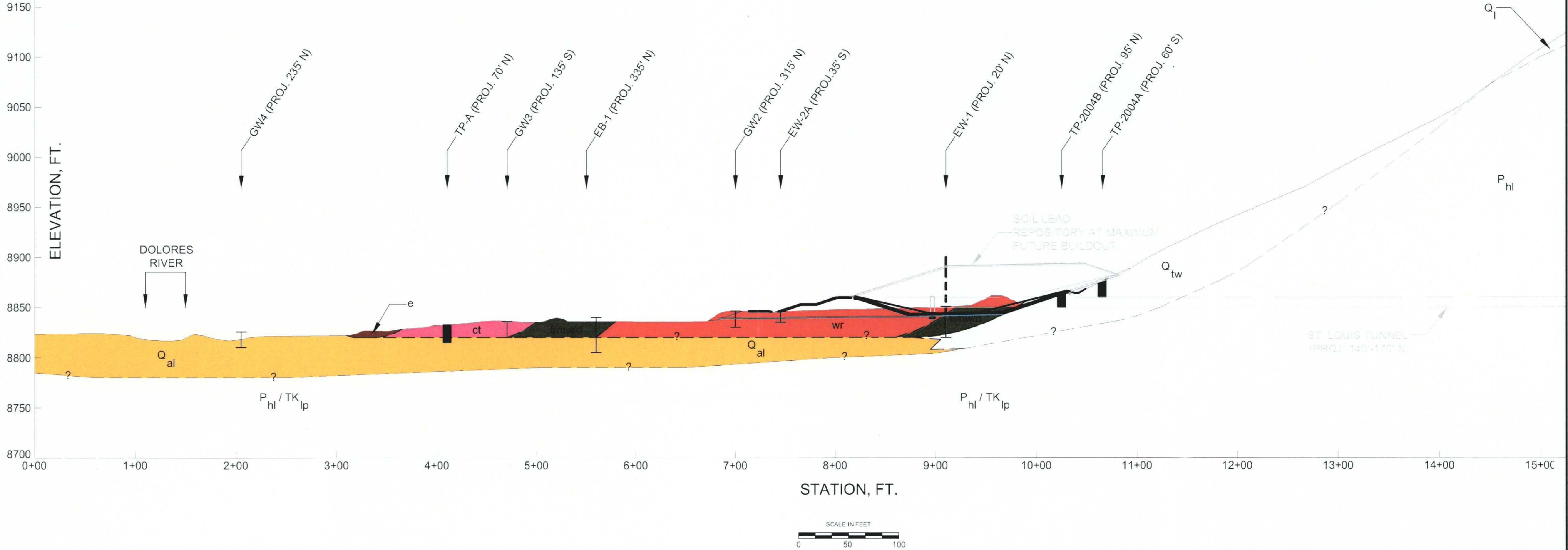
RICO-ARGENTINE SITE - OU01
REMOVAL ACTION WORK PLAN

GEOLOGIC MAP
SHEET 2 OF 2

AECOM PROJECT NO. 60157757

FIGURE A2-1C



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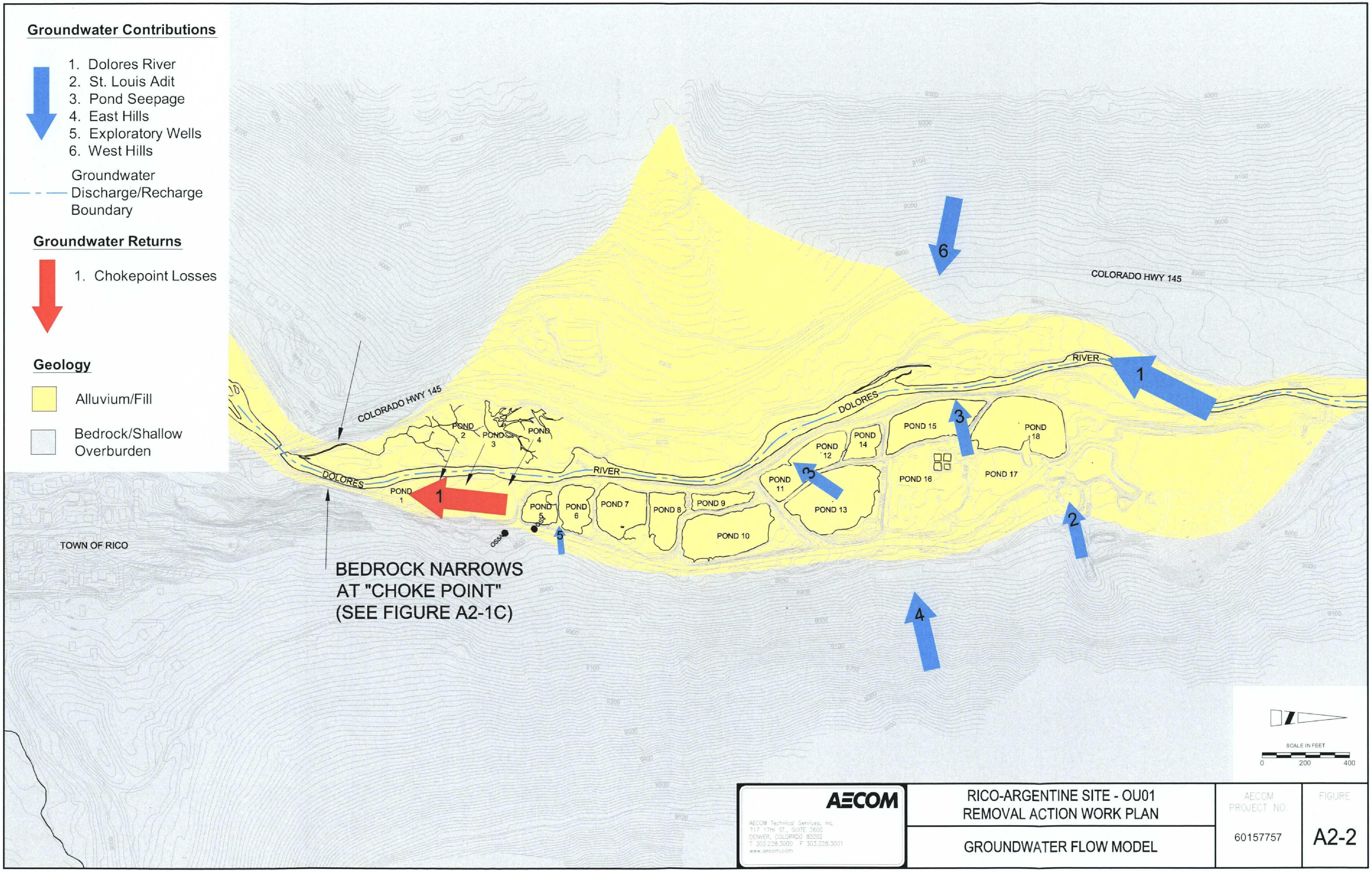
RICO-ARGENTINE SITE - OU01 REMOVAL ACTION WORK PLAN	AECOM PROJECT NO.	FIGURE	
GEOLOGIC SECTION	60157757	A2-1D	


Groundwater Contributions
1. Dolores River
2. St. Louis Adit
3. Pond Seepage
4. East Hills
5. Exploratory Wells
6. West Hills
Groundwater Discharge/Recharge Boundary
Groundwater Returns
1. Chokepoint Losses
Geology
Alluvium/Fill
Bedrock/Shallow Overburden
COLORADO HWY 145
DOLORES
RIVER
POND 1
POND 2
POND 3
POND 4
POND 5
POND 6
POND 7
POND 8
POND 9
POND 10
POND 11
POND 12
POND 13
POND 14
POND 15
POND 16
POND 17
POND 18
TOWN OF RICO
BEDROCK NARROWS AT "CHOKE POINT" (SEE FIGURE A2-1C)
SCALE IN FEET
0
200
400
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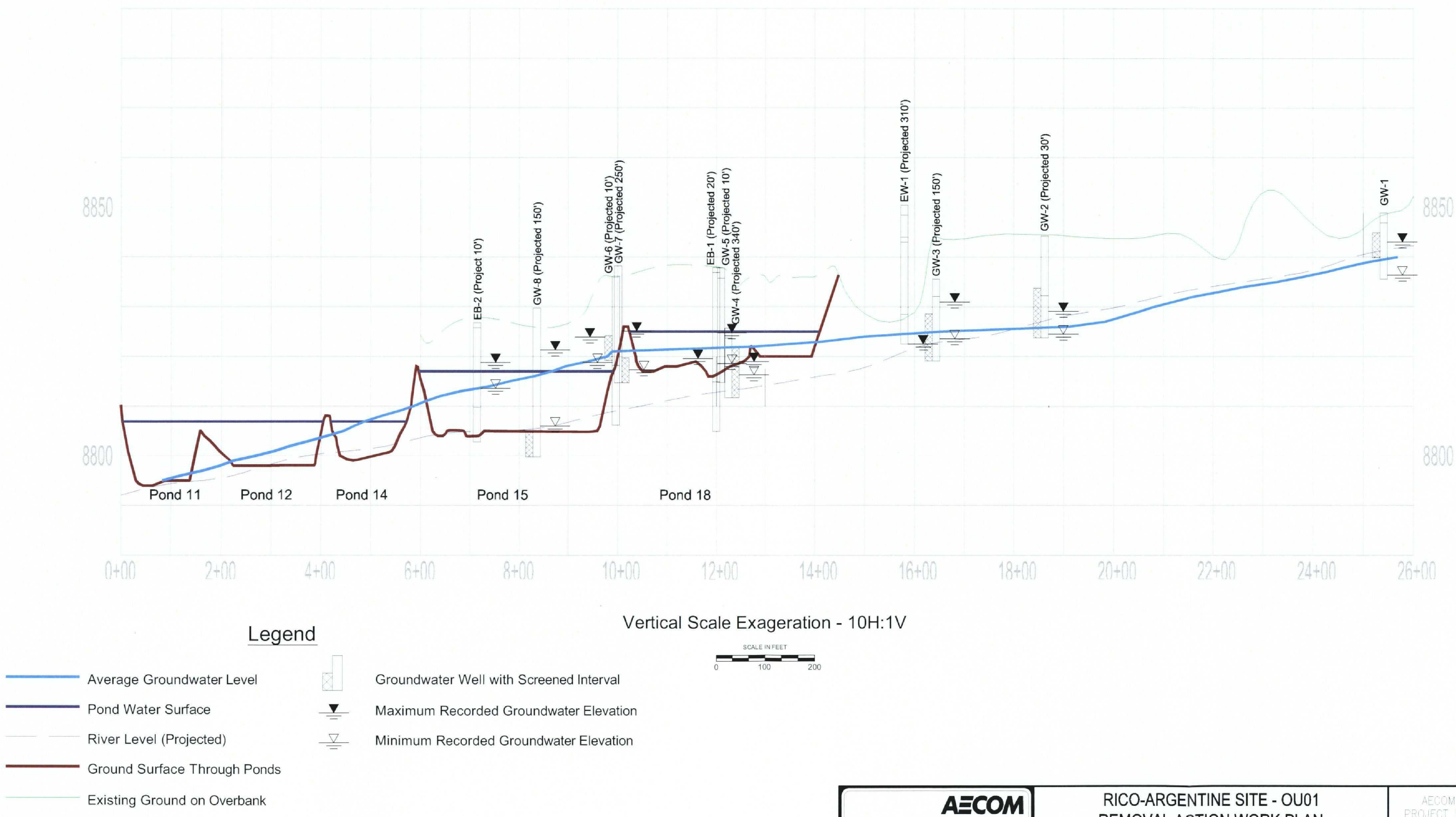
RICO-ARGENTINE SITE - OU01
REMOVAL ACTION WORK PLAN
GROUNDWATER FLOW MODEL
AECOM PROJECT NO.
60157757
FIGURE
A2-2



AECOM	RICO-ARGENTINE SITE - OU01 REMOVAL ACTION WORK PLAN	AECOM PROJECT NO.	FIGURE
AECOM Technical Services, Inc. 717 17th ST., SUITE 2600 DENVER, COLORADO 80202 T 303.228.3000 F 303.228.3001 www.aecom.com	GROUNDWATER PROFILE	60157757	A2-3

Appendix A

Geologic/Geotechnical Data

-Well/Boring Logs

-Test Pit Logs

-Geotechnical Data

Well/Boring Logs

- Anderson Engineering/SEH, 2008
- SEH, 2004
- CDPHE, 2003
- Dames and Moore, 1981

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-1	COORDINATES OR LOCATION: LAT: 37.7066 LON: -108.0317
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 11' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/8/08 DATE COMPLETED: 10/8/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -6.5	-5 to -7 (Shelby tube)		50%		CLAYEY SILT WITH SOME SAND AND GRAVEL; BROWN, MOIST
-6.5 to -17.5					SILTY SAND AND GRAVEL, DARK BROWN, MOIST
	-11 to -12.5 (SPT)	12 9 3	50%		WATER - SATURATED
	-15 to -16.5 (SPT)	13 33 27	50%		SATURATED COBBLES AND BOULDERS
-17.5	-17 to -18.5 (SPT)	50 / ½"	0		REFUSAL AT 17.5'

Depth scale: 0, -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -20, -21, -22, -23, -24, -25, -26, -27, -28

TD = 17.5'

NOTES:

= SHELBY TUBE   = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-2	COORDINATES OR LOCATION: LAT: 37.7055 LON: -108.0313
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 14' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/8/08 DATE COMPLETED: 10/8/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	DESCRIPTION
0 to -3				SANDY SILT, BROWN, MOIST
-3 to -5				CLAYEY SILT, MINOR SAND AND GRAVEL, RED, MOIST
-5 to -8	SPT -5 to -6.5	8, 6, 4	25%	SANDY SILT WITH GRAVEL, BROWN, MOIST
-8 to -11	SPT -10 to -11.5	24, 4	0	CLAYEY SILT WITH SOME GRAVEL AND COBBLES, BROWN, MOIST
-11 to -12		3		RED WET SILTY SAND - CALCINE TAILINGS - NO RECOVERY-
-12 to -15.5	SPT -12 to -13.5; Shelby tube -13.5 to -15; SPT -15 to -16.5	15, 15, 8; 15	67%; 50%	BROWN CLAYEY SILT WITH GRAVEL AND COBBLES, MOIST, WOOD DEBRIS, WATER DRILLING ON COBBLE, WOOD DEBRIS IN SPLIT SAMPLE
-15.5 to -17		14, 50/3	50%	SAND AND GRAVEL, SATURATED, WITH COBBLE
-17 to -18.5	SPT -17.5 to -19	24, 37	50%	SILT WITH SOME SAND AND WOOD DEBRIS, BROWN, SATURATED
-18.5 to -21.5		38		SAND AND GRAVEL, SATURATED WITH COBBLES DRILLING REFUSAL @ 18.5

TD = 18.5'

NOTES: TRY SHELBLY AT 5'. HIT ROCK, SWITCHED TO SPT, TOO MANY ROCKS. DROVE SPT @12' - HIT WOOD - RECOVERED ~ 1', SMELLS LIKE CREOSOTE. TRY SHELBY AT 14-16 - HIT WOOD. NOTE: COBBLES THROUGHOUT HOLE

I = SHELBY TUBE ⊠ = STANDARD SPLIT SPOON (SPT)

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BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-3	COORDINATES OR LOCATION: LAT: 37.7055 LON: -108.0307
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" · FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -10	-4.5 to -6 (standard split spoon)	6 4 4	10%		RED SILTY SAND WITH GRAVEL, CALCINE TAILINGS
-10 to -28	-10 to -12 (Shelby tube)		0%		NO RECOVERY. SHELBY PUSHED 24" THEN FREE FELL ANOTHER 12". DRILLED INTO VOID. BOTTOM OF AUGER AT 10'. TAPE MEASURED TO 16'. USED MIRROR TO LOOK INTO BORRING. CAVITY OPENS TO THE SOUTH. MOVING RIG TO ANOTHER LOCATION ~ 30' TO THE WEST.

TD = 10'

NOTES: DRILLER THOUGHT WE HIT VOID AT ~ 8'.

I = SHELBY TUBE ☒ = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-3R	COORDINATES OR LOCATION: LAT: 37.7054 LON: -108.0308
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 24' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -13					SILTY SAND AND GRAVEL, BROWN
-10 to -12	Shelby tube		75%		PIECE OF OXIDIZED MINE WASTE ROCK IN TIP OF SHELBY
-13 to -15					SANDY SILT WITH CLAY, BROWN, MOIST
-15 to -22	SPT (-15 to -16.5)	3 2 2	50%		OXIDIZED (RED/ORANGE/YELLOW) SAND WITH SOME SILT AND FINE GRAVEL. MOIST
-20 to -22	Shelby tube		60%		
-22 to -24.5					LT BROWN WET SANDY SILT. WATER
-24.5 to -25.5	SPT (-25 to -26.5)	10			SATURATED COARSE SAND, GRAY
-25.5 to -28		10 10	50%		SATURATED COARSE SAND AND GRAVEL; GRAY / BROWN

Depth scale: 0, -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, -14, -15, -16, -17, -13, -19, -20, -21, -22, -23, -24, -25, -26, -27, -28

TD =

NOTES: 20' SHELBY - ROCK AT BOTTOM; COMPLETELY SEALED END.

I = SHELBY TUBE ⊠ = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-3R	COORDINATES OR LOCATION: LAT: 37.7054 LON: -108.0308
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 24' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
-29 to -37					SATURATED COARSE SAND AND GRAVEL; GRAY / BROWN
-30 to -31.5	SPT	10 10 13	50%		
-35 to -36.5	SPT	17 17 14	50%		

Depth scale: -29 to -57

TD = 35'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-4	COORDINATES OR LOCATION: LAT: 37.7042 LON: -108.0301
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 11' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/7/08 DATE COMPLETED: 10/7/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -2					SILTY SAND AND GRAVEL
-2 to -3					RED SILTY GRAVEL
-3 to -7.5	-5 to -6.5 (SPT)	6 4 4	50%		SILTY SAND WITH GRAVEL, MINOR CLAY
-7.5 to -8.5					BLACK SILT WITH CLAY
-8.5 to -12.5	-10 to -11.5 (SPT)	4 3 2	75%		CLAYEY GRAVEL WATER
-12.5 to -18	-15 to -16.5 (SPT)	0 4 8	75%		SILTY GRAVEL WITH CLAY SATURATED GRAY / DK BROWN SILTY CLAY
-18 to -20					SATURATED - DK BROWN FLOWING SILT
-20 to -22.5	-20 to -21.5 (SPT)	50 / 4"	30%		SILTY SAND AND GRAVEL, DK BROWN

TD = 20.5'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-6	COORDINATES OR LOCATION: LAT: 37.7039 LON: -108.0305
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 11' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/7/08 DATE COMPLETED: 10/7/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -2					SILTY SAND AND SOME GRAVEL
-2 to -5					SANDY GRAVEL AND SILT
-5 to -14	-5 to -6.5 (SPT)	4 10 6	25%		SANDY SILT WITH GRAVEL
	-10 to -11.5 (SPT)	3 5 4	1%		HIT ROCK - NO SAMPLE RECOVERY
-14 to -18	-15 to -17 (Shelby tube)				SATURATED SILT WITH SOME MINOR SMALL GRAVEL
-18 to -22	-20 to -21.5 (SPT)	24/6 50/6	25%		SILTY SAND AND GRAVEL, SATURATED
-22 to -24					COBBLES - REFUSAL @ 23'

TD = 23'

NOTES:

I = SHELBY TUBE ⊠ = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-6	COORDINATES OR LOCATION:	LAT: 37.7027 LON: -108.0305
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 10' GWL DEPTH: N/A	(ENCOUNTERED) (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/7/08 DATE COMPLETED: 10/7/08	

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -3					BROWN SILTY SAND AND GRAVEL
-3 to -7	-4.5 to -6 (California split spoon)	30	50%		SANDY GRAVEL
-7 to -10					WET BROWN SANDY SILT AND GRAVEL
-10 to -15.5	-10 to -11.5 (Standard split spoon)	10 7 7	50%		SATURATED LIGHT BROWN SAND AND GRAVEL
-15.5 to -20	-15 to -17 (Shelby tube)		75%		COBBLES
-20 to -23.5	-20 to -22 (Shelby tube)		25%		TAN SATURATED SAND

TD = 25' NOTES: ATTEMPTED SHELBY @ 15'. ROCK IN AUGER. SHELBY DESTROYED WITH NO SAMPLE RECOVERY. PUSHED OUT PLUG WITH CENTER PUNCH.

= SHELBY TUBE
= STANDARD SPLIT SPOON (SPT)
= CALIFORNIA SPLIT SPOON

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-7	COORDINATES OR LOCATION: LAT: 37.7018 LON: -108.0299
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 10 (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -7	SPT -5 to -6.5	24 50 / 4"	25%		BROWN SILTY SAND AND GRAVEL WET BROWN SILTY SAND AND GRAVEL
-7 to -9					SOME CLAY PRESENT
-9 to -12	SPT -10 to -11.5	35 19 34	60%		SATURATED SAND AND GRAVEL WITH SOME SILT
-12 to -15					SANDY SILT WITH GRAVEL AND COBBLES
-15 to -17	Shelby tube -15 to -17		100%		SILTY SAND WITH GRAVEL
-17 to -25	SPT -20 to -21.5	4 9 11	100%		SILT WITH FINE SAND, SATURATED, LIGHT BROWN

TD = 21.5'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-8	COORDINATES OR LOCATION: LAT: 37.7008 LON: -108.0301
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 6 (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -7				Silty sand and gravel	SILTY SAND AND GRAVEL, BROWN
-5 to -6.5	Standard split spoon	9 8 29	50%		WATER, SATURATED
-7 to -10.7				Sandy silt with gravel	SATURATED BROWN SANDY SILT WITH GRAVEL
-11 to -12.5	Standard split spoon	21 30 20	50%	Cobbles and boulders	COBBLES AND BOULDERS REFUSAL @ 12'

TD = 12'

NOTES:

⌶ = SHELBY TUBE ⊠ = STANDARD SPLIT SPOON

ANDERSON ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-9	COORDINATES OR LOCATION: LAT: 37.7062 LON: -108.0314
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: ~ 17' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" FLUID USED: N/A	DATE STARTED: 10/8/08 DATE COMPLETED: 10/8/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -9.1	-5 to -7 (Shelby tube)		100%		RED SILTY SAND; CALCINE TAILINGS
-9.1 to -12.2	-10 to -11.5 (Standard split spoon)	4 4 4	70%		THIN LAYER OF GRAY SATURATED SILT @ 11'
-12.2 to -16	-15 to -17 (Shelby tube)				RED SILTY SAND, CALCINE TAILINGS
-16 to -22.8			100%		SAND AND GRAVEL - SATURATED, BLACK
	-20 to -21.5 (Standard split spoon)	12 24 30	50%		REFUSAL @ 23.5'

TD = 23.5'

NOTES:

= SHELBY TUBE   = STANDARD SPLIT SPOON

ANDERSON
ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-10	COORDINATES OR LOCATION: LAT: 37.7046 LON: -108.0308
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: ~ 13' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: $7\frac{5}{8}$" / FLUID USED: N/A	DATE STARTED: 10/7/08 DATE COMPLETED: 10/7/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -4					BROWN SILTY SAND AND GRAVEL
-4 to -13	-5 to -7 (Shelby tube)		<25%		BROWN CLAYEY SILT WITH MINOR GRAVEL
	-9 to -11 (Shelby tube)		33%		
-13 to -14					SATURATED DARK BROWN - GRAY SILT WITH MINOR GRAVEL
-14 to -17	-14 to -15.5 (SPT)	10 26 50 / 2	<25%		SATURATED BROWN SAND AND GRAVEL, SOME MINOR SILT ROCK ENCOUNTERED AT 17' REFUSAL @ 17'

Depth scale: 0, -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -20, -21, -22, -23, -24, -25, -26, -27, -28

TD = 17'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-11	COORDINATES OR LOCATION: LAT: 37.7063 LON: -108.0308
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: ~20 (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: HOLLOW STEM AUGER	HOLE DIA: 7⅝" / FLUID USED: N/A	DATE STARTED: 10/8/08 DATE COMPLETED: 10/8/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	DESCRIPTION
0 to -4.5	-2.5 to -4.5 (Shelby tube)		70%	BROWN CLAYEY SILT, MOIST MINOR GRAVEL
-4.5 to -16.5	-5 to -7 (Shelby tube)		100%	RED SILTY SAND, CALCINE TAILINGS
	-7.5 to -9.5 (Shelby tube)		100%	
	-12.5 to -14.5 (Shelby tube)		100%	
	-15 to -17 (Shelby tube)		100%	
-16.5 to -20.5	-17.5 to -19.5 (Shelby tube)		100%	RED SILT - CALCINE TAILINGS
-20.5 to -21	-20 to -21.5 (SPT)	27 50 / 1"	50%	SAND AND GRAVEL, SATURATED RED / BROWN WITH COBBLES REFUSAL @ 21'

TD = 21'

NOTES: ATTEMPTED SHELBY @ 10'; 0 RECOVERY

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-12R	COORDINATES OR LOCATION: LAT: 37.7073 LON: -108.0297
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 43' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: ODEX	HOLE DIA: 6" / FLUID USED: AIR	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -5					BROWN SANDY SILT WITH SOME CLAY AND GRAVEL
-5 to -9					BROWN CLAYEY SILT WITH SOME SAND AND SMALL GRAVEL
-9 to -11					ROCK
-11 to -12.5					RED SILTY SAND WITH GRAVEL, CALCINE TAILINGS
-12.5 to -22	-13 to -14.5 (SPT)	6 4 4	50%		BROWN SANDY SILT WITH SOME CLAY AND GRAVEL
-22 to -28					BROWN SANDY SILT WITH GRAVEL

TD =

NOTES:

= SHELBY TUBE   = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-12R	COORDINATES OR LOCATION: LAT: 37.7073 LON: -108.0297
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 43' (ENCOUNTERED) GWL DEPTH: N/A (STATIC)
DRILLING METHOD: ODEX	HOLE DIA: 6" / FLUID USED: AIR	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	PROFILE	DESCRIPTION
-29 to -33				
-33 to -37				SANDY SILT AND GRAVEL, MINOR CLAY
-37 to -39				ROCK
-39 to -41				SANDY SILT AND GRAVEL, MINOR CLAY
-41 to -43				RED COBBLES WITH SOME SILT AND SAND
-43 to -46				GRAVEL WITH SOME SILT
-46 to -47				SILTY GRAVEL
-47 to -50				CLAYEY SILT WITH MINOR GRAVEL, MOIST - WET
-50 to -55				SANDY GRAVEL WITH SOME SILT, MOIST. HARDER DRILLING
-55 to -57				TD

TD = 55' NOTES: SOME GRAVEL IS CRUSHED ROCK FROM ODEX HAMMER HIT. UNKNOWN ORIGINAL SIZE.

I = SHELBY TUBE ⊠ = STANDARD SPLIT SPOON (SPT)

ANDERSON
ENGINEERING COMPANY, INC

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-13	COORDINATES OR LOCATION:	LAT: 37.7033 LON: -108.0305
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 8' GWL DEPTH: N/A	(ENCOUNTERED) (STATIC)
DRILLING METHOD: ODEX	HOLE DIA: 6"	FLUID USED: AIR	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
0 to -5					BROWN SILT AND SAND WITH SOME GRAVEL
-5 to -7					WOOD DEBRIS
-7 to -8.5					SILTY SAND AND GRAVEL, MOIST, BROWN
-8.5 to -16					SATURATED SILTY SAND AND GRAVEL, BROWN
-16 to -18					SATURATED LIGHT BROWN SILTY GRAVEL
-18 to -28+					SATURATED LIGHT BROWN SILTY SAND GRADES MORE SILTY

TD =

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON ENGINEERING COMPANY, INC.

BORING LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: DH-13	COORDINATES OR LOCATION:	LAT: 37.7033 LON: -108.0305
LOGGED BY: K. COSPER CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 8' GWL DEPTH: N/A	(ENCOUNTERED) (STATIC)
DRILLING METHOD: ODEX	HOLE DIA: 6"	FLUID USED: AIR	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION
-29					
-30					
-31					
-32					
-33					
-34					
-35					
-36					
-37					
-38					
-39					
-40					
-41					
-42					
-43					
-44					
-45					
-46					
-47					
-48					LESS SILTY
-49					
-50					
-51					
-52					
-53					
-54					
-55					TD
-56					
-57					

TD = 55'

NOTES:

= SHELBY TUBE = STANDARD SPLIT SPOON (SPT)

ANDERSON ENGINEERING COMPANY, INC.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EW-1

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Western	11/20/2004	11/21/2004	odex

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		EW-1	Feet Site	8,850.5 Feet Site	5.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ___° ___' ___"
Long ___° ___' ___"
Local Grid Location
1389193 Feet ☒ N ☐ S
2268176 Feet ☒ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24	17-20 15-11		FILL: Brown, dense, GRAVELLY SAND, some organics in surface soils.					35					Note: Compressive Strength = SPT N value
2 SS	24	5-7 7-7	2	Brown, medium dense, fine to coarse grained CLAYEY SAND, with gravel.	SC				14					Note: Length att. on split spoon = 24"
3 SS	24	5-11 5-2	4–6						16					
4 SS	24	4-4 6-3	8	Brown, loose, fine to coarse grained, CLAYEY SAND.	SC				10					
				Brown, loose to very dense, fine to coarse grained, CLAYEY SAND and gravel	SC									
5 SS	24	2-8 4-5	10						12					
1 SH	6		12											approx. 6 inches recovery
6 SS	24	5-4 2-4	14						6					
2 SH	24		16											
7 SS	24	6-8 10-8	18–20						18					
8 SS	24	50	22–24	Brown-gray, very dense, fine-coarse GRAVEL, with sand and clay	GP				50					

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Daniel R. Reed

Firm SEH Inc 421 Frenette Drive Chippewa Falls, WI 54729 www.sehinc.com Tel: 715.720.6200 Fax: 715.720.6300

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number EW-1 Use only as an attachment to Form 4400-122.

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			26	Brown-gray, very dense, fine-coarse GRAVEL, with sand and clay	GP									
			28	End of boring at 28' (refusal)										

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name: St. Louis Ponds Area, Rico, Colorado	License/Permit/Monitoring Number: AARCOE0105.00		Boring Number: EW-2A
Boring Drilled By: Name of crew chief (first, last) and Firm: Jeff Pennell, Layne-Western	Date Drilling Started: 11/21/2004	Date Drilling Completed: 11/21/2004	Drilling Method: odex

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			Feet Site	8,846.4 Feet Site	5.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ___ ° ___ ' ___ "
Long ___ ° ___ ' ___ "
Local Grid Location: 1389198 Feet ☒ N ☐ S; 2268004 Feet ☒ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24	1-3 12-9		FILL: Brown, dense, GRAVELLY SAND, some organics in surface soils.					15					Note: Compressive Strength = SPT N value. Note: Length att. on split spoon = 24"
2 SS	24	3-7 4-5	2	Brown, loose, fine to coarse grained CLAYEY SAND, with gravel.	SC				11					
3 SS	24		4-6	Brown, loose, SANDY CLAY to clayey sand, with gravel.	CL									
4 SS	24	3-4 3-3	8	Brown, medium stiff, SANDY CLAY, with gravel	CL-ML				7					
5 SS	24	5-8 8-17	10	Brown, stiff, SANDY CLAY to clayey sand, with gravel	CL-ML				16					
			12	End of boring at 12' (abandoned)										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Daniel R. Reed

Firm: SEH Inc, 421 Frenette Drive, Chippewa Falls, Wi 54729, www.sehinc.com Tel: 715.720.6200 Fax: 715.720.6300

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EB-1

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Western	11/15/2004	11/18/2004	hsa/odex

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		EB-1	8,820.9 Feet Site	8,837.9 Feet Site	8.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ___° ___' ___"
Long ___° ___' ___"
Local Grid Location: 1388792 Feet ☒ N ☐ S; 2267917 Feet ☒ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24	29-44 18-14		FILL: Gray, very dense, WASTE ROCK, igneous cobbles					62					Note: Compressive Strength = SPT N value Note: Length att. on split spoon = 24"
2 SS	24	5-8 8-12	2	FILL ("Calcine Tailings"): Purple-maroon to gray, loose to medium dense, fine to very fine grained, SILTY SAND, rare gravel					16					
3 SS	24	4-9 8-11	4						17					
4 SS	24	5-5 7-7	6						12					
1 SH	24		8											
2 SH	24		10											
4 SS	24	5-4 4-3	12		SM				8					
3 SH	24		14											
5 SS	24	2-2 6-16	16						8					
4 SH	24		18											
6 SS	24	12-7 9-7	20						16					
5 SH	24		22											
			24		GP									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Daniel R. Reed

Firm SEH Inc 421 Frenette Drive Chippewa Falls, WI 54729 www.sehinc.com Tel: 715.720.6200 Fax: 715.720.6300

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number EB-1 — Use only as an attachment to Form 4400-122.

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			26	Brown, dense, fine to coarse GRAVEL (alluvium), much fine to coarse grained sand.										
7 SS	24	22-20 24-50	28		GP				44					
			30											
			32											
				End of boring at 33' (refusal)										

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watersbed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EB-2

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Western	11/19/2004	11/19/2004	hollow stem auger

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		EB-2	8,818.8 Feet Site	8,826.8 Feet Site	8.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N feet ☐ S ☐ E Feet ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				FILL: Gray, very dense, WASTE ROCK, igneous cobbles										
1 SS	24	4-6 4-7	2	FILL("Calcine Tailings"): Purple-maroon to gray, loose to medium dense, fine to very fine grained, SILTY SAND, rare gravel	SM				10					Note: Compressive Strength = SPT N value Note: Length att. on split spoon = 24"
2 SS	24	4-4 5-4	4						9					
3 SS	24	3-3 6-3	6						9					
4 SS	24	3-2 1-1	8						3					
			10											
			12											
5 SS	24	1-1 1-1	14						2					
			16											
			18	Brown, dense, fine to coarse GRAVEL (alluvium), much fine to coarse grained sand.	GP									
6 SS	24	12-24 50	20						74					
			22											
			24	End of boring at 24'										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Daniel R. Reed

Firm **SEH Inc** 421 Frenette Drive Chippewa Falls, WI 54729 www.sehinc.com Tel: 715.720.6200 Fax: 715.720.6300

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
St. Louis Ponds Area, Rico, Colorado	AARCOE0105.00	EB-2D

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Pennell Layne-Western	11/18/2004	11/19/2004	odex

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			Feet Site	8,826.0 Feet Site	5.0 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NW 1/4 of NW 1/4 of Section 25, T 40 N, R 10 W

Lat ____ ° ____ ' ____ "
Long ____ ° ____ ' ____ "

Local Grid Location
1388306 Feet ☒ N ☐ S
2267920 Feet ☒ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
			Rico, Colorado

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–1	FILL: Gray, very dense, WASTE ROCK, igneous cobbles										
			1–18	FILL ("Calcine Tailings"): Purple-maroon to gray, loose to medium dense, fine to very fine grained, SILTY SAND, rare gravel	SM									Note: Compressive Strength = SPT N value Note: Length att. on split spoon = 24" 3" diameter split spoon used (no shelby rec)
1 SH	24													
2 SH	24													
1 SS	24													
3 SH	24													
4 SH	24													
2 SS	24	4-1 1-4							2					
			18–24	Brown, dense, fine to coarse GRAVEL (alluvium), much fine to coarse grained sand.	GP									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Daniel R. Reed

Firm **SEH Inc** 421 Frenette Drive Chippewa Falls, WI 54729 www.sehinc.com
Tel: 715.720.6200
Fax: 715.720.6300

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number EB-2D   Use only as an attachment to Form 4400-122.

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties						RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200		
				End of boring at 24' (abandoned - moved to EB-2, approx. 10' to east)											

CDPHE
Colorado Department of Public Health and Environment

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW1	Weii Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 4ft. To 9 ft bgs		Well Diameter:	2 Inch
Depth of Well (L^{w}):	9 ft.	Depth to Water Before Development (L^{l}):	6.5 ft.
Height of Water Column ($L^{w} - L^{l}$):	6 ft.		
Depth to Top of Sediment (L^{l})	9 fl.	Sediment Thickness ($L^{w} - L^{l}$):	Na ft.
Well Volume:	0.96 gal.		
Total Volume Pumped:	30 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	30+ volumes pumped on 10/16/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW1

Date	Temp	pH	Cond	Gallons Purged	Observations
10/16/02	11.2	7.37	359	27	Slightly turbid
10/16/02	10.8	7.36	359	29	Clear, Slightly turbid

* Sample collection continued after well development includes well development purge volatnes

10/16/02 @ 1345	Sample Collected

Lithology

0-9 feet	Nadve rocky cobble material

Presented By	Date	Checked By	Date

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WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW2	Well Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consultine		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 10.5 ft. To 20.5 ft bgs		Well Diameter:	2 Inch
Depth of Well (L*):	20.5 ft.	Depth to Water Before Development (L'):	6.5 ft
Height of Water Column (L* - L'):	2.0 ft.		
Depth to Top of Sediment (L')	20.5 ft.	Sedhnent Thickness (L* - L'):	Na ft.
Well Volume:	0.32 gal.		
Total Volume Pumped:	5 gal.		
Number of Well Volumes Pumped	(total vohime pumped/well volume):	4x volumes pumped on 10/16/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW2

Date	Temp	pH	Cond	Gallons Purged	Observations
10/16/02	11.9	7.29	1004	Purged dry four times	Clear
				Total of 5 gallcns max	

* Sample collection continued after well development includes well development purge volumes

10/16/02 @ 1620	Sample Collected

Lithology

0-12 feet	Spent pyretic ore with mixed coble and rock. Ore materials are green and purple in color. Leach pad liner ai 12 feet bgs
12-20.5 feet	Native rocky cobble material

Presented By	Date	Checked By	Date

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WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW3	Well Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilhng Method:	4-Inch Hollow Stem Aueer	Weather:	Clear Skies, Partly Sunry 60°F
Development Company:	Kayenta Consultine		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 7 ft. To 16.5 ft bgs		Well Diameter:	2 Inch
Depth of Well (L*):	16.5 ft.	Depth to Water Before Development (L'):	6.5 ft.
Height of Water Cohmn (L* - L'):	9.5 R		
Depth to Top of Sediment (L')	16.5 ft.	Sediment Thickness (L* - L'):	Na ft.
Well Volume:	1.12 gal.		
Total Volume Pumped:	15 gal.		
Number of Well Volumes Pumped	(total volnne pumped/well volume):	14 volumes pumped on 10/16/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW3

Date	Temp	pH	Cond	Gallons Purged	Observations
10/16/02	11.6	6.46	1526	5	Slightly turbid
10/16/02	10.9	6.45	1529	7	Slightly turbid
10/16/02	10.6	6.44	1484	8	Slightly turbid
10/16/02	10.S	6.42	1512	9	Clear, Slightly turbid

* Sample collection contimed after well development includes well development purge volumes

10/16/02 @ 1100	Sample Collected

Lithology

0-3.5 feet	Spent pyretic ore with mixed coble and mck.
3.5-16.5 feet	Native rocky cobble material

Presented By	Date	Checked By	Date

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WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Numhen RLP-GW4	Well Location: Rico Light Industrial Park

Time / Date:	10/16/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kaventa Consulting		Slight Breeze
Date Development Started:	10/16/02	Date Development Completed:	10/16/02
Screen Intervals: 4ft. To 14 ft bgs		Well Diameter:	2 Inch
Depth of Well (L*):	14 ft.	Depth to Water Before Development (L'):	7 ft.
Height of Water Column (L* - L'):	7 ft.		
Depth to Top of Sediment (L')	14ft.	Sediment Thickness (L* - L'):	Na ft.
Well Volume:	1.12 gal.		
Total Volume Pumped:	27 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	25+ volumes pumped on 10/16/02	0.16 galloas per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW4

Date	Temp	pH	Cond	Gallons Purged	Observations
10/16/02	14.0	7.20	1385	24	Slightly turbid
10/16/02	13.5	7.20	1380	25	Shghtly turbid
	13.7	7.20	1383	27	Shghtly turbid

* Sample collection continued after well development includes well development purge volumes

10/16/02 @ 1600	Sample Collected

Lithology

0-2 feet bgs	Gravel fill material
2-14 feet bgs	Rip rap materials and cobble

Presented By	Date	Checked By	Date

CDPHE

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW5	Well Location: Rico Light Industrial Park

Time / Dale:	10/17/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sumny 60°F
Development Company:	Kaventa Consulting		Shght Breeze
Date Development Started:	10/17/02	Date Develapment Completed:	10/17/02
Screen Intervals: 18 ft. to 23 ft bgs		Well Diameter:	2 Inch
Depih of Well (L*):	23 ft.	Depth to Water Before Development (L'):	15 ft.
Height of Water Column (L* - L'):	S ft.		
Depth to Top of Sediment (L')	14ft.	Sediment Thickness (L* - L'):	Na ft.
Well Volume:	1.28 gal.		
Total Volume Pumped:	46 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	46 gallons purged on 10/17/02	0.16 gallons per fool on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW5

Date	Temp	pH	Cond	Gallons Purged	Observadons
10/17/02	13.8	6.89	2620	45	Slightly turbid
10/17/02	13.4	6.90	2620	45.5	Clear, Slightly turbid
	13.7	6.91	2610	46	Clear

* Sample collectian continued after weB development includes well development purge volumes

10/17/02 @ 1145 Sample Collected

Lithology

0-2 feet bgs	Waste rock materials
2-23 feet bgs	Purple roasted tailings, wet

Presented By	Date	Checked By	Date

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4300 Cherry Creek Drive South
Denver, CO 80246

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW6	Well Location: Rico Light Industrial Park

Time / Date:	10/17/02	Elevation :	8,800 msl
Drilhng Method:	4-Inch Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/17/02	Date Development Completed:	10/17/02
Screen Intervals: 12 ft. to 17 ft bgs		Well Diameter:	2 Inch
Depth of Well (L"):	30 ft.	Depth to Water Before Development (L'):	25 ft.
Height of Water Column (L" - L'):	S ft.		
Depth to Top of Sediment (L')	30ft.	Sediment Thickness (L" - L'):	Na ft.
Well Volume:	0.S gal.		
Total Volume Pumped:	8 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	8+ volumespurged on 10/17/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW6

Date	Temp	pH	Cond	Gallons Purged	Observations
10/17/02	13.1	6.49	4000	6	Slightly turbid
10/17/02	12.6	6.38	3970	7	Clear, Slightly turbid
10/17/02	13.1	6.42	4110	8	Clear
			* Purged dry total of 8 times, Collected sample on 9th recharge		

* Sample collection continued after well development includes well development purge volumes

10/17/02 @ 1645	Sample Collected

Lithology

0-18 feet bgs	Purple roasted tailings mixed with waste rock and river cobble
1S-30 feet bgs	Native Rock, Cobble

Presented By	Date	Checked By	Date

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WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number RLP-GW7	Well Location: Rico Light Industrial Park

Time / Date:	10/17/02	Elevation :	8,800 msl
Drilling Method:	4-Inch Hollow Stem Aueer	Weather:	Clear Skies, Panly Sunny 60°F
Development Company:	Kayenta Consulting		Slight Breeze
Date Development Started:	10/17/02	Date Development Conpleted:	10/17/82
Screen Intervals: 19 ft. to 24 ft bgs		Well Diameter	2 hich
Depth of Well (L^w):	24 ft.	Depth to Water Before Development (L^i):	19 ft.
Height of Water Column (L^w - L^i):	5 ft.		
Depth to Top of Sediment (L^i)	24 ft.	Sediment Thickness (L^w - L^i):	Na ft.
Well Volume:	0.8 gal.		
Total Volume Pumped:	35 gal.		
Number of Well Volumes Pumped	(total volume punped/well volume):	43+ volumes purged on 10/17/02	0.16 gallons per foot on a 2-hich Well

Monitoring Well Sample Data : Well RLP-GW7

Dale	Temp	pH	Cond	Gallons Purged	Observations
10/17/02	15.5	6.51	1679	26	Slightly tnbid
10/17/02	15.7	6.51	1719	35	Clear

* Sanple collection continued after well development inchides well development purge voltunes

10/17/02 @ 1550	Sample Collected

Lithology

0-24 feet bgs	Waste rock / river cobble

Presented By	Date	Checked By	Date

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4300 Cherry Creek Drive South
Denver, CO 80246

WELL DEVELOPMENT DATA AND SAMPLE FORM SUMMARY

Records Management Data

Project Number: Rico Light Industrial Park	Project Name: Rico Light Industrial Park
Well Number: RLP-GW8	Well Location: Rico Light Industrial Park

Time / Date:	10/17/02	Elevation :	8,800 msl
Drilling Method:	4-Incb Hollow Stem Auger	Weather:	Clear Skies, Partly Sunny 60°F
Development Company:	Kaventa Consulting		Slight Breeze
Dale Development Started:	10/17/02	Date Development Completed:	10/17/02
Screen Intervals: 25 ft. to 30 ft bgs		Well Diameter:	2 Inch
Depth of Well (L*):	30 ft.	Depth to Water Before Development (L'):	25 ft.
Height of Water Column (L* - L'):	5 ft.		
Depth to Top of Sediment (L'):	30 ft.	Sediment Thickness (L* - L'):	Na ft.
Well Volume:	0.8 gal.		
Total Volume Pumped:	24 gal.		
Number of Well Volumes Pumped	(total volume pumped/well volume):	24+ volumes purged on 10/17/02	0.16 gallons per foot on a 2-Inch Well

Monitoring Well Sample Data : Well RLP-GW8

Date	Temp	pH	Cond	Gallons Porged	Observations
10/17/02	13.0	6.46	2510	22	Clear, Slightly turbid
10/17/02	12.9	6.58	2520	23	Clear, Slightly turbid
10/17/02	12.5	6.64	2520	24	Clear, Slightly turbid

* Sample collectian continued after well development includes well development purge volumes

10/17/02 @ 1735	Sample Collected

Lithology

0-1 feet bgs	Fill material
1-24 feet bgs	Red purple sllmes, roasted tailings, saturated
24 – 30 feet bgs	Native materials, river cobble

Presented By	Dale	Checked By	Date

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BORING B-1

SURFACE ELEVATION 8833
COORDINATES

OTHER TESTS	TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	LL (%)	PL (%)	PI (%)	BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
												0
										18	SPT	5
										9	SPT	10
										7	SPT	15
			14							18	SPT	20
										28	D	25
										21	SPT	30
										50/5"	SPT	
												35
												40
												45
												50
												55
												60
												65
												70

SYMBOLS — DESCRIPTION

GM

BROWN FINE TO COARSE SANDY GRAVEL WITH SILT MEDIUM DENSE

GRADES WITH LENSES OF SILTY SAND AND SANDY SILT

COLORS GREY AND CAUSES WITH SOME CLAY
GRADES LOOSE TO MEDIUM DENSE

GRADES LOOSE

GRADES WITH MORE GRAVEL AND MEDIUM DENSE

FILL

GM

DARK BROWN TO BLACK SILTY GRAVEL WITH SAND, MEDIUM DENSE

SM

BROWN SILTY FINE TO COARSE SAND WITH SOME GRAVEL MEDIUM DENSE

GM

BROWN SANDY GRAVEL, DENSE TO VERY DENSE
AUGER REFUSAL AT 33 FEET
BORING COMPLETED AT 33.5 FEET ON 6/3/81
WATER ENCOUNTERED AT 21.8 FEET ON 6/3/81

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" SAMPLER
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:

1. THE SOIL CONDITIONS ARE DESCRIBED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM, PLATE A-3.
2. BLOW COUNT HAS BEEN TAKEN AS THE NUMBER OF BLOWS REQUIRED TO DRIVE A SAMPLER TO ONE-FOOT PENETRATION USING A 140 POUND WEIGHT FALLING 30 INCHES.

LOG OF BORING

DAMES & MOORE

FILE ANACONDA RICO 04010-002-1608

BORING B-2

SURFACE ELEVATION 8834
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
												0
										26	SPT	5
GRADATION				22			32	17	15	8	SPT	10
										12	SPT	15
										21	SPT	20
						E7	67	51	16	5	SPT	
						M6				11	SPT	25
										Sil for 1/4"	SPT	30
												35
												40
												45
												50
												55
												60
												65
												70

SYMBOLS	DESCRIPTION
SC	BROWN CLAYEY SAND WITH GRAVEL MEDIUM DENSE
SM	BROWN AND GREY GRAVELLY SAND WITH SOME CLAY
SC	YELLOW AND BROWN FINE TO COARSE CLAYEY SAND WITH GRAVEL LOOSE
	LUMBER FRAGMENTS AT 15 FEET GRADES MEDIUM DENSE
GM	GREY & BROWN SANDY GRAVEL WITH SOME SILT MEDIUM DENSE
MH	DARK BROWN AND BLACK FINE SANDY SILT SOFT TO MEDIUM STIFF

FILL (0 to about 23 feet)

AUGER REFUSAL AT 30.5 FEET
BORING COMPLETED AT 30.5 FEET ON 6/4/81
WATER ENCOUNTERED AT 20.7 FEET ON 6/3/81

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:
SEE PLATE A - 1A.

LOG OF BORING

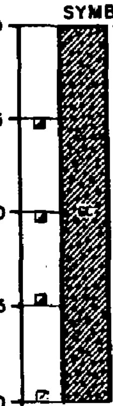
DAMES & MOORE

FILE ANACONDA RICO 04010-082-1408

BORING B-3

SURFACE ELEVATION 8836
COORDINATES

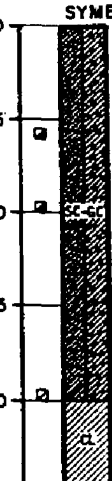
OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	DESCRIPTION
												0	BROWN SANDY CLAYEY GRAVEL WITH SAND LOOSE
				12						2	SPT	5	SAMPLER DRIVEN THROUGH COBBLE
										32	SPT	10	GRADES MEDIUM DENSE
										7	SPT	15	
										23	SPT		
												20	AUGER REFUSAL AT 20' BORING COMPLETED AT 20 FEET ON E/5/81 NO WATER ENCOUNTERED
												25	
												30	



BORING B-4

SURFACE ELEVATION 8835
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	DESCRIPTION
												0	BROWN CLAYEY SAND AND GRAVEL WITH COBBLES LOOSE
										5	SPT	5	
GRADATION				22		15	27	21	6	5	SPT	10	
												15	
										1	SPT	20	DARK BROWN SILTY AND SANDY CLAY WITH ORGANIC MATERIAL
												25	AUGER REFUSAL AT 24.5 FEET BORING COMPLETED AT 24.5 FEET ON 6/6/81 NO WATER ENCOUNTERED
												30	



KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- D - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:
SEE PLATE A - 1A.

LOG OF BORING

DAMES & MOORE

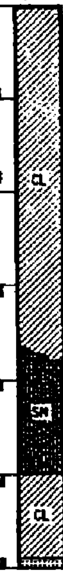
FILE ANACONDA RICO 04010-082-1608

BORING B-5

SURFACE ELEVATION 8839
COORDINATES

OTHER TESTS	TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	LL (%)	PL (%)	PI (%)	BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
pH, SULFATES						5	31	20	11	11	SPT	5
										11	SPT	10
										32	SPT	15
				43						11	SPT	20
						13	44	21	21	38	SPT	25
										50 For 4 1/2"	SPT	30

SYMBOLS / DESCRIPTION



- 0: BROWN SANDY CLAT WITH SOME CRAYEL STIFF
- 15: GRADES WITH MORE GRAVEL
- 20: YELLOW-BROWN GRAVELLT SAND WITH SOME CLAY AND WOOD FRAGMENTS LOOSE TO MEDIUM DENSE
- 25: DARK BROWN SANDY CLAY

FILL (0 to 25 feet)

AUGER REFUSAL AT 29.5 FEET
WEATHETED SANDSTONE SEDROCR
BORING COMPLETED AT 30.25 FEET ON 5/8/81
WATER ENCOUNTERES AT 25.5 FEET ON 6/5/81

BORING B-6

SURFACE ELEVATION 8TS3
COORDINATES

OTHER TESTS	TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	LL (%)	PL (%)	PI (%)	BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
										2/4"	SPT	0
				26			25	19	7	5	SPT	5
										50/0"	SPT	10

SYMBOLS / DESCRIPTION

- DARK BROWN SILTT SAND WITH SRAVEL AND COBBLAS MEDIUM DENSE
- DARK BROWN CLAYEY SILT AND SILTY CLAY WITH GRAVEL AND COBBLES MEDIUM STIFF

AUGER REFUSAL AT 10 FEET
BORING COMPLETED AT 11 FEET ON 5/7/81
WATTR ENCOUNTERED AT 5 FEET ON 6/7/81

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURSED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" SIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:
SEE PLATE A - IA.

LOG OF BORING

DAMES & MOORE

FILE ANACONDA RICO 09010-062-1605

BORING B-7

SURFACE ELEVATION 8808
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
												0
										7	SPT	5
										9	SPT	10
										33	SPT	15
												20
												25
												30

SYMBOLS — DESCRIPTION

- GM — BROWN AND GREY SANDY GRAVEL WITH SOME SILT LOOSE
- SC — BROWN CLAYEY SAND WITH GRAVEL LOOSE TO MEDIUM DENSE
- GM — BROWN SANDY GRAVEL WITH SILT MEDIUM DENSE TO DENSE

AUGER REFUSAL AT 17.5 FEET
BORING COMPLETED AT 17.5 FEET ON 6/7/81
WATER LEVEL ENCOUNTERED AT 15 FEET

BORING B-8

SURFACE ELEVATION 8814
COORDINATES

OTHER TESTS	STRENGTH TEST RESULTS: TYPE OF TEST	CONFINING PRESSURE (psf)	PEAK SHEAR STRENGTH (psf)	% PASSING NO. 200 SIEVE	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LL (%)	PL (%)	PI (%)	SAMPLING: BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET
												0
										2	SPT	5
GRADATION				10						25/6"	SPT	10
												15
												20
												25
												30

SYMBOLS — DESCRIPTION

- SM — BROWN SILTY FINE TO COARSE SAND WITH SOME GRAVEL LOOSE TO MEDIUM DENSE
- ML — DARK BROWN CLAYEY SILT WITH SAND
- GM — BROWN SANDY FINE GRAVEL WITH CLAY

AUGER REFUSAL AT 12 FEET
BORING COMPLETED AT 12 FEET ON 6/7/81
WATER LEVEL ENCOUNTERED AT 9 FEET ON 6/7/81

KEY

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- ◪ INDICATES STANDARD PENETRATION TEST SAMPLE
- P - IN BLOW COUNT COLUMN INDICATES SAMPLER HYDRAULICALLY PUSHED

SAMPLE TYPE

- U - DAMES & MOORE "U" BIT
- T - DAMES & MOORE THIN-WALL
- P - DAMES & MOORE PISTON
- SPT - STANDARD SPLIT-SPOON
- D - DAMES & MOORE "D" SAMPLER

NOTE:
SEE PLATE A - 1A.

Added 2/19/07

LOG OF BORING

DAMES & MOORE

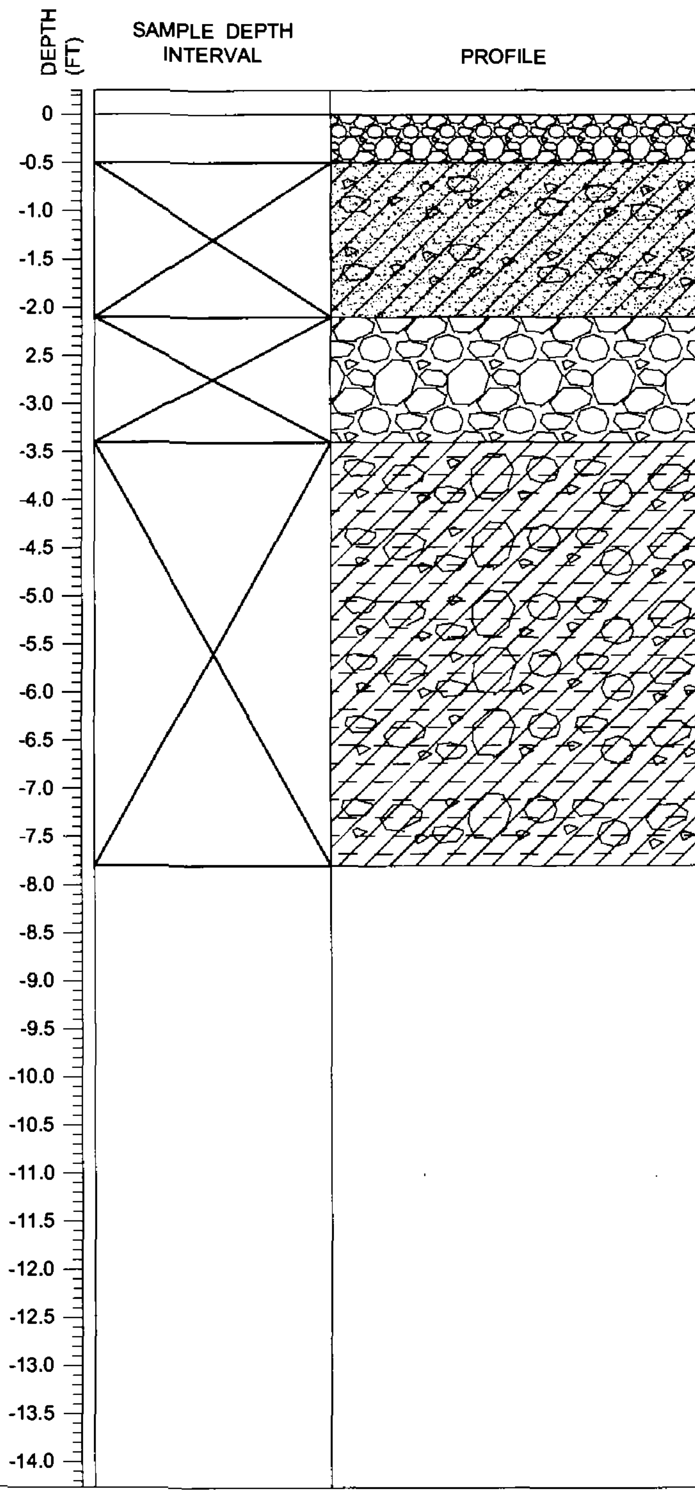
PLATE A-1E

Test Pit Logs

- Anderson Engineering / SEH, 2008
- SEH, 2004
- SEH, 2001
- Anderson Engineering, 1996

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-1	COORDINATES OR LOCATION: LAT: 37.7075 LON: -108.0321
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 7.8' (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08



DESCRIPTION

GRAVEL ON SURFACE WITH ROAD BASE COURSE

DARK BROWN SILTY SAND WITH GRAVEL

RED TAILINGS (CALCINE) WITH GRAVEL AND ROCK (2" - 8") APPROX 20-25% ROCK

DARK BROWN CLAY SILT WITH GRAVEL AND ROCK (2" - 12") APPROX 10 - 12% ROCK, MOIST

CAVITY AT 7.0' DUE TO FOCK FALL, WATER ENCOUNTERED AT 7.8'

TD = 7.8' NOTES: PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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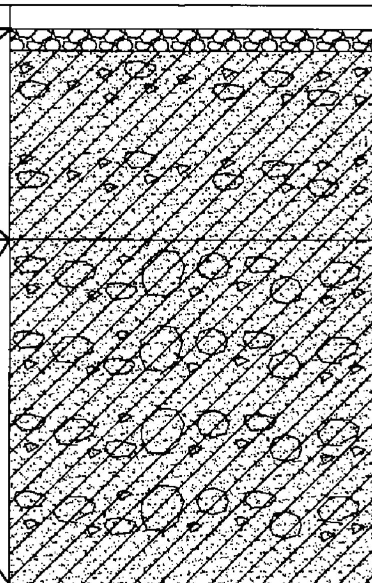
TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-2		COORDINATES OR LOCATION: LAT: 37.7063 LON: -108.0321
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:		GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -2.2	X		GRAVEL ON SURFACE DARK BROWN, SILTY SAND WITH MINOR GRAVEL
-2.2 to -5.8	X		BROWN SANDY SILT SOIL WITH GRAVEL AND ROCK (2" TO 14" DIAMETER), MOIST, APPROX 10 TO 12% ROCK TRENCH CAVE IN ON SIDE WALLS



Depth scale (FT): 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 6.0'

NOTES: DID NOT CONTINUE DUE TO TRENCH CAVE IN ON SIDE WALLS

X = SAMPLE, BACKFILLED AND COMPACTED

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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-3	COORDINATES OR LOCATION:	LAT: 37.7054 LON: -108.0317
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -1.8	X		SURFACE GRAVEL ¾" SANDY SILT, DARK BROWN SOIL, MINOR AMOUNTS OF GRAVEL
-1.8 to -2.8	X		SILTY SAND, REDISH BROWN, MIXED SOIL AND TAILINGS (CALCINE)
-2.8 to -7.8	X		SANDY SILT, BROWN WITH GRAVEL, MOIST, SOME LARGE ROCK (6" - 12" DIAMETER) MOIST

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 7.8' NOTES: NO WATER, TEST PIT BACKFILLED, COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF INTERVAL

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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-4	COORDINATES OR LOCATION:	LAT: 37.7054 LON: -108.0312
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 7.8' GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0			GRAVEL ON SURFACE, SILTY SAND, DARK BROWN CLAY, MINOR AMOUNTS OF TAILINGS
-0.5			
-1.0			SANDY SILT WITH MINOR GRAVEL, LIGHT BROWN
-1.5			
-2.0			CLAY SILT WITH MINOR SAND, BROWN SOIL ON GRAVEL, MOIST
2.5			
-3.0			
-3.5			
-4.0			
-4.5			
-5.0			CLAY SILT WITH MINOR SAND WITH GRAVEL, DARK BROWN, SOME TAILINGS MIXED WITH SOIL, MOIST AT TOP, WET AT 7.5'
-5.5			
-6.0			
-6.5			
-7.0			
-7.5			
-8.0			
-8.5			
-9.0			
-9.5			
-10.0			
-10.5			
-11.0			
-11.5			
-12.0			
-12.5			
-13.0			
-13.5			
-14.0			

TD = 7.8' NOTES: WATER; BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-5	COORDINATES OR LOCATION: LAT: 37.7054 LON: -108.0305
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)

DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT): 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
		GRAVEL ON SURFACE UNDERLAING BY DK BROWN SILTY SAND
X		YELLOW BROWN MINE WASTE WITH GRAVEL AND ROCK (2" - 6" DIAMETER), 70% ROCK
X		BROWN SOIL MIXED WITH RED CALCINE TAILINGS, SILTY SAND CONTAINS GRAVEL AND ROCK (2" TO 12" DIAMETER) APPROX 20-30% ROCK
X		BROWN SOIL, SILTY SAND MIXED WITH CALCINE TAILINGS, MINOR GRAVEL AND SOME ROCK, APPROX 5% ROCK

TD = 7.9' NOTES: TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-6		COORDINATES OR LOCATION:	LAT: 37.7041 LON: -108.0311
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:		GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08	

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -2.0	X		GRAVEL ON SURFACE, DARK GRAY SOIL WITH WASTE ROCK, GRAY IN COLOR (1" = 6"), SOIL SANDY, WITH GRAVEL
-2.0 to -3.8	X		REDDISH SANDY TAILINGS WITH GRAVEL
-3.8 to -7.3	X		CREAM COLORED SANDY TAILINGS WITH GRAVEL AND ROCK (2" TO 12"). PYRITE MATERIAL MIXED IN THE ZONE. NOTE: THIS LAYER WAS COLAPSING AND UNDER CUTTING WHEN EXCAVATED

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 7.3' NOTES: NO WATER, PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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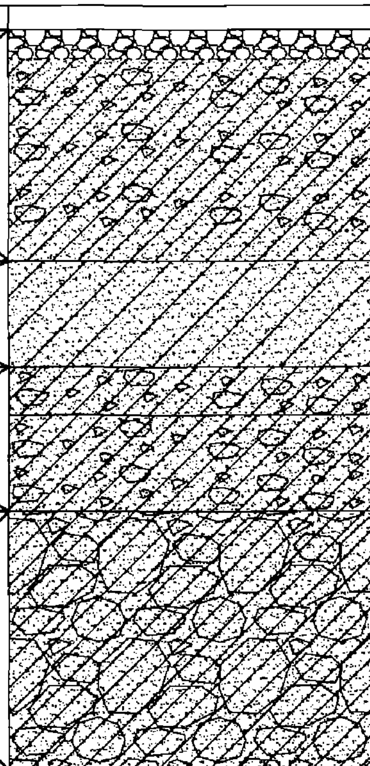
TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-7	COORDINATES OR LOCATION: LAT: 37.7040 LON: -108.0304
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08



DEPTH (FT)	SAMPLE DEPTH INTERVAL	DESCRIPTION
0 to -2.4	X	TOP SURFACE GRAVEL BROWN SOIL - SILTY SAND WITH GRAVEL
-2.4 to -3.5	X	BROWN SOIL / TAILINGS, SANDY SOIL WITH SOME SILT MIXED WITH RED TAILINGS (CALCINE)
-3.5 to -4.0	X	TAILINGS, LIGHT BROWN TO CREAM IN COLOR, RED OXIDATION STAIN ON ROCK
-4.0 to -5.0		BROWN SOIL, SILTY SAND WITH GRAVEL
-5.0 to -7.7	X	LARGE ROCK ENCOUNTERED (12" - 18") WITH BROWN SOIL, SILTY SAND WITH GRAVEL, CONTAINS MINOR AMOUNT OF TAILINGS

TD = 7.7'

NOTES: NO WATER ENCOUNTERED, PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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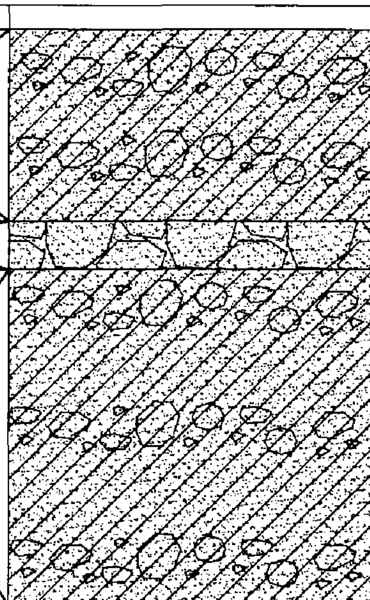
TEST PIT LOG			PAGE 1 OF 1
SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-8	COORDINATES OR LOCATION:	LAT: 37.7044 LON: -108.0299
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)

DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/14/08 DATE COMPLETED: 10/14/08



DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -2.0	X		BROWN SILTY SAND WITH GRAVEL AND COBBLES, MOIST APPROX 5% ROCK, MINOR LENSES OF CALCINE TAILINGS
-2.0 to 2.5	X		GRAY/WHITE SANDY GRAVEL, SEVERAL BOULDERS (>= 12" DIAMETER AT THIS LAYER) 60% ROCK
2.5 to -6.0	X		BROWN SANDY SILT WITH GRAVEL AND COBBLES, MOIST, APPROX 5% ROCK

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 6.0' NOTES: TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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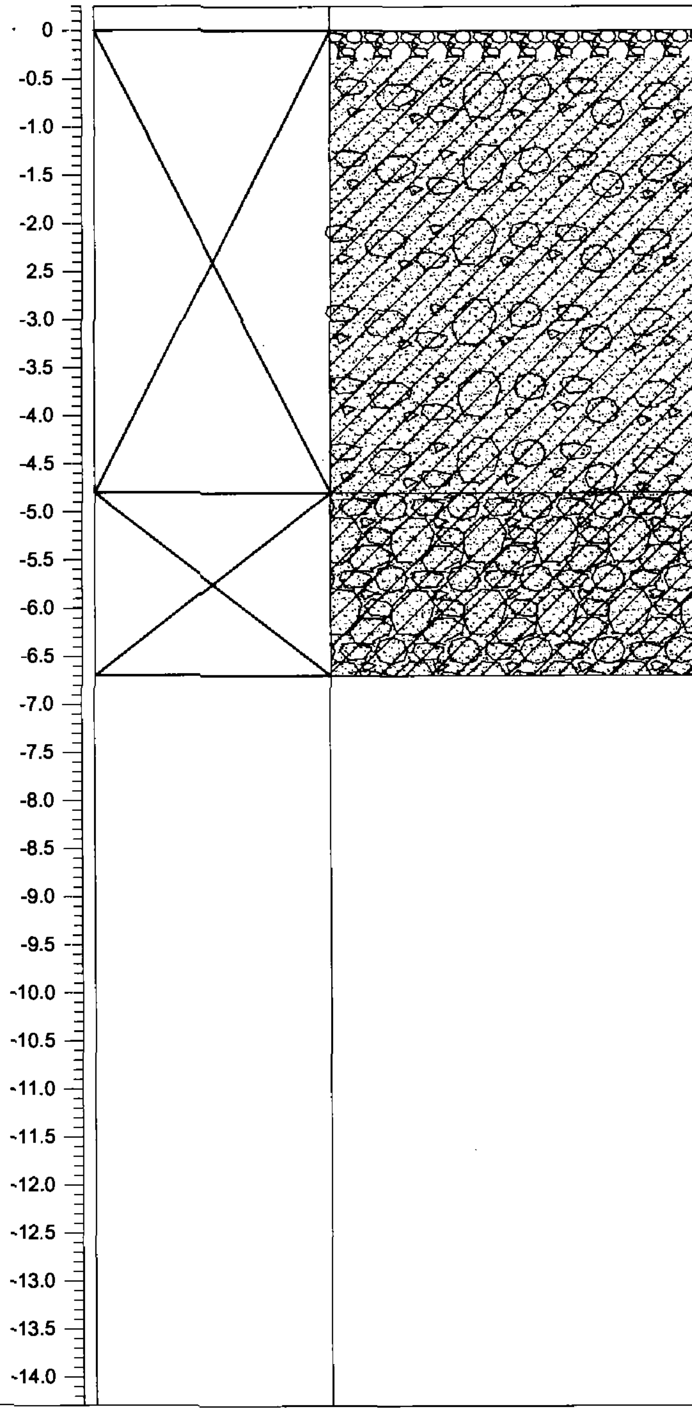
TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-9	COORDINATES OR LOCATION:	LAT: 37.7029 LON: -108.0300
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 6.7' GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT) | SAMPLE DEPTH INTERVAL | PROFILE | DESCRIPTION



GRAVEL ON SURFACE - BROWN SOIL, SILTY SAND WITH GRAVEL AND ROCK (2" TO 14")

BROWN SOIL WITH REDDISH TAILINGS, SILTY SAND WITH GRAVEL AND ROCK (2" TO 16"), MIXED WITH TAILINGS, INTERSPERSED CLUMPS OF TAILINGS

TD = 6.7' NOTES: TEST PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF INTERVAL

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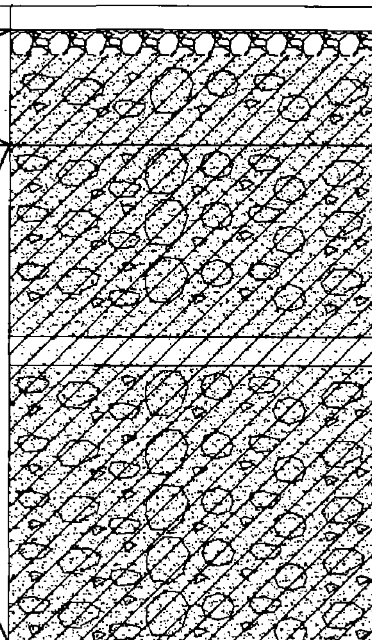
TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-10	COORDINATES OR LOCATION: LAT: 37.7025 LON: -108.0305
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 6.4' (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -1.2	X		GRAVEL ON SURFACE, BROWN SILTY SAND WITH GRAVEL, SOME SMALL ROCK.
-1.2 to -3.2	X		BROWN SILTY SAND WITH GRAVEL AND ROCK (2" TO 12")
-3.2 to -3.5	X		SOIL LAYER - BROWN SILTY SAND, NO GRAVEL
-3.5 to -6.4	X		BROWN SILTY SAND WITH GRAVEL AND ROCK (2" - 12")



Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 6.4' NOTES: PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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TEST PIT LOG				PAGE 1 OF 1
SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-11		COORDINATES OR LOCATION:	LAT: 37.7016 LON: -108.0302
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:		GWL DEPTH: 4.2' GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08	

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -0.5	X (0 to -1.3)		LIGHT BROWN SANDY SILT SOIL WITH ¾" GRAVEL
-0.5 to -1.3			LIGHT BROWN SANDY SILT SOIL WITH SOME GRAVEL
-1.3 to 2.5	X (-1.3 to 2.5)		BROWN SILTY SAND AND GRAVEL, SOME ROCK (2" - 8") INTERMIXED TAILS (CREAM AND RED) VERY MOIST
2.5 to -3.0	X (2.5 to -5.0)		LAYER OF TAILINGS
-3.0 to -5.0			BROWN CLAY SAND SILT WITH GRAVEL AND ROCK (2" TO 12") INTERMIXED TAILS (LIGHT BROWN / CREAM TO RED)

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 5.0' NOTES: PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
ENGINEERING COMPANY, INC

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-12	COORDINATES OR LOCATION:	LAT: 37.7013 LON: -108.0304
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 3.4' GWL DEPTH:	(ENCOUNTERED) (STATIC)

DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/9/08 DATE COMPLETED: 10/9/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -1.0	X		BROWN IN COLOR - SOIL SILTY SAND WITH GRAVEL
-1.0 to -2.0	X		BROWN SOIL - SILTY SAND WITH GRAVEL AND ROCK (2" - 8")
-2.0 to -3.0	X		BROWN SOIL, SANDY SILT WITH GRAVEL AND ROCK, SOIL WET
-3.0 to -4.0	X		BROWN SOIL, SILTY SAND WITH SOME CLAY, GRAVEL AND ROCK, SOIL SATURATED

DEPTH (FT) scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 4.0' NOTES: PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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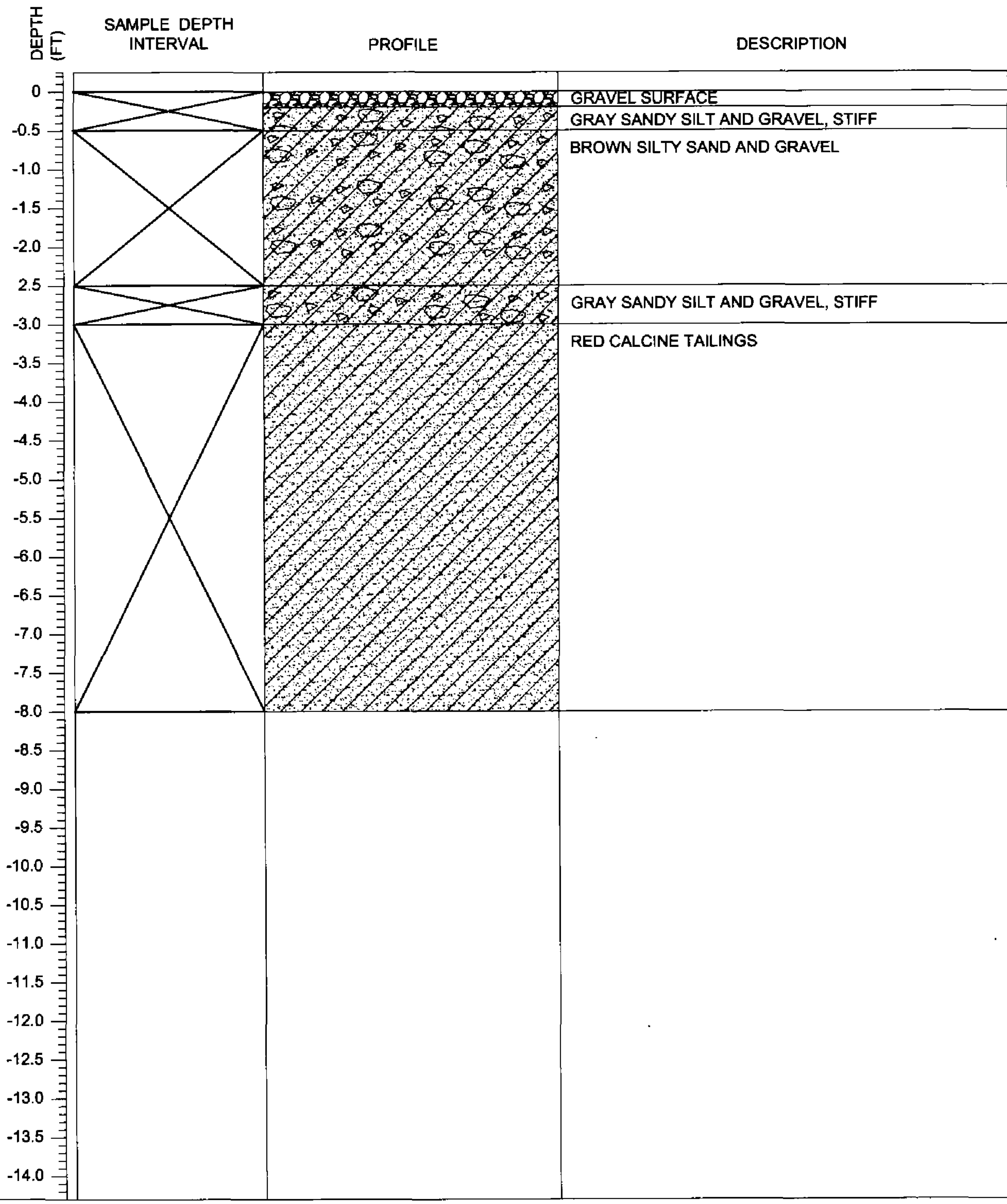
ENGINEERING COMPANY, INC.

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-13	COORDINATES OR LOCATION:	LAT: 37.7065 LON: -108.0306
LOGGED BY: KC CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: 0' NO WATER GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/14/08 DATE COMPLETED: 10/14/08



TD = 8.0' NOTES: TEST PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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ENGINEERING COMPANY, INC

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-14	COORDINATES OR LOCATION: LAT: 37.7069 LON: -108.0312
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)

DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0			GROUND BASE COURSE
-0.5 to -8.0	X		RED TO DARK RED TAILINGS (CALCINE) MIXED WITH STAINED ROCK AND TAILINGS (CREAM COLORED), ROCK MIXED IN TAILINGS (2" - 14") APPROX 10% ROCK, SANDY TO SILTY SAND, MOIST

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 8.0' NOTES: NO WATER, BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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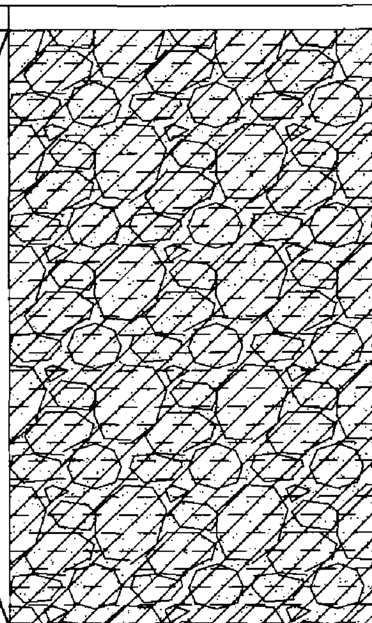
TEST PIT LOG			PAGE 1 OF 1
SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-15	COORDINATES OR LOCATION:	LAT: 37.7054 LON: -108.0292
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -6.2	X		LIGHT BROWN SOIL, SILTY CLAY WITH SOME SAND, LARGE ROCK (2" - 32") APPROX 35 - 40% ROCK
-6.2			LARGE ROCK DIFFICULT TO DIG

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 6.2' NOTES: TP 15 AND 16 SIMILAR SOIL PROFILES; TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON ENGINEERING COMPANY, INC.

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-16	COORDINATES OR LOCATION:	LAT: 37.7064 LON: -108.0294
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0	X		GRAVEL ON SURFACE, LIGHT BROWN SOIL, SILTY CLAY WITH SOME SAND, LARGE ROCK (2" TO ~48") APPROX 30 - 35% ROCK
-0.5			
-1.0			
-1.5			
-2.0			
2.5			
-3.0			
-3.5			
-4.0			
-4.5			
-5.0			
-5.5			LARGE ROCK, VERY DIFFICULT EXCAVATION
-6.0			
-6.5			
-7.0			
-7.5			
-8.0			
-8.5			
-9.0			
-9.5			
-10.0			
-10.5			
-11.0			
-11.5			
-12.0			
-12.5			
-13.0			
-13.5			
-14.0			

TD = 5.4' NOTES: TP-16 AND 15 SIMILAR SOIL PROFILES; TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
ENGINEERING COMPANY, INC

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-17	COORDINATES OR LOCATION: LAT: 37.7074 LON: -108.0294
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -2.7	X		GRAVEL ON SURFACE, BROWN SANDY SILT WITH SOME CLAY AND GRAVEL ROCK (2" TO 14"), ROCK CONTENT 25%
-2.7 to -4.0	X		VERY DARK BROWN SILTY CLAY WITH ORGANIC MATERIAL, LITTLE TO NO ROCK, SOIL MOIST
-4.0 to -6.4	X		BROWN SILTY CLAY WITH SOME LARGE ROCK (6" - 14") APPROX 5% SOIL MOIST

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD =

NOTES: TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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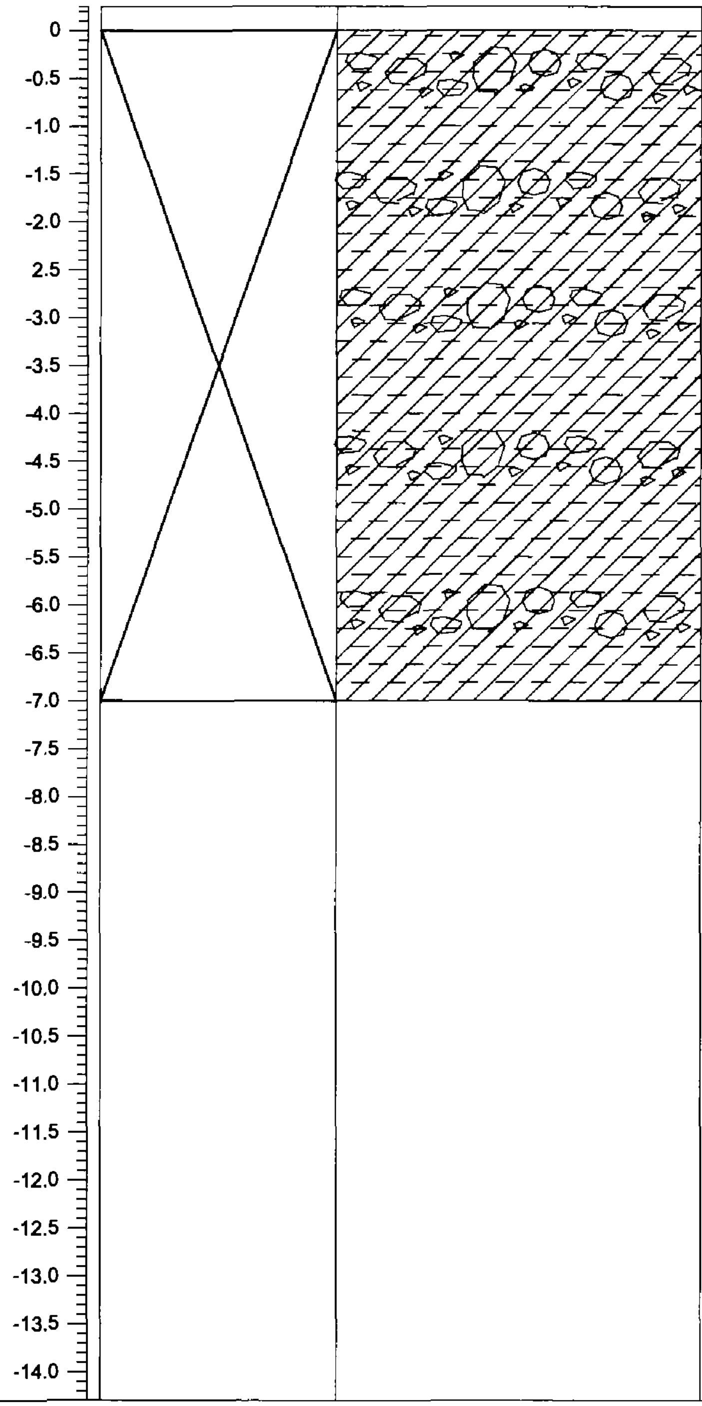
TEST PIT LOG				PAGE 1 OF 1
SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-18		COORDINATES OR LOCATION:	LAT: 37.7074 LON: -108.0299
LOGGED BY: KC CHECKED BY: SDA	SURFACE ELEVATION:		GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/14/08 DATE COMPLETED: 10/14/08	

DEPTH (FT) | SAMPLE DEPTH INTERVAL | PROFILE | DESCRIPTION



BROWN CLAY SILT WITH GRAVEL AND COBBLES (3" - >12") APPROX 10% ROCK, MOIST

TD = 7.0' NOTES: TEST PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
ENGINEERING COMPANY, INC.

TEST PIT LOG				PAGE 1 OF 1
SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-19		COORDINATES OR LOCATION:	LAT: 37.7069 LON: -108.0298
LOGGED BY: KC CHECKED BY: SDA	SURFACE ELEVATION:		GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08	

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -4.4	X		BROWN CLAYEY SILT WITH GRAVEL AND ROCK (2" - 12"), MOIST, 25-30% ROCK
-4.4			CONCTRETE FOUNDATION

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 4.4' NOTES: TEST PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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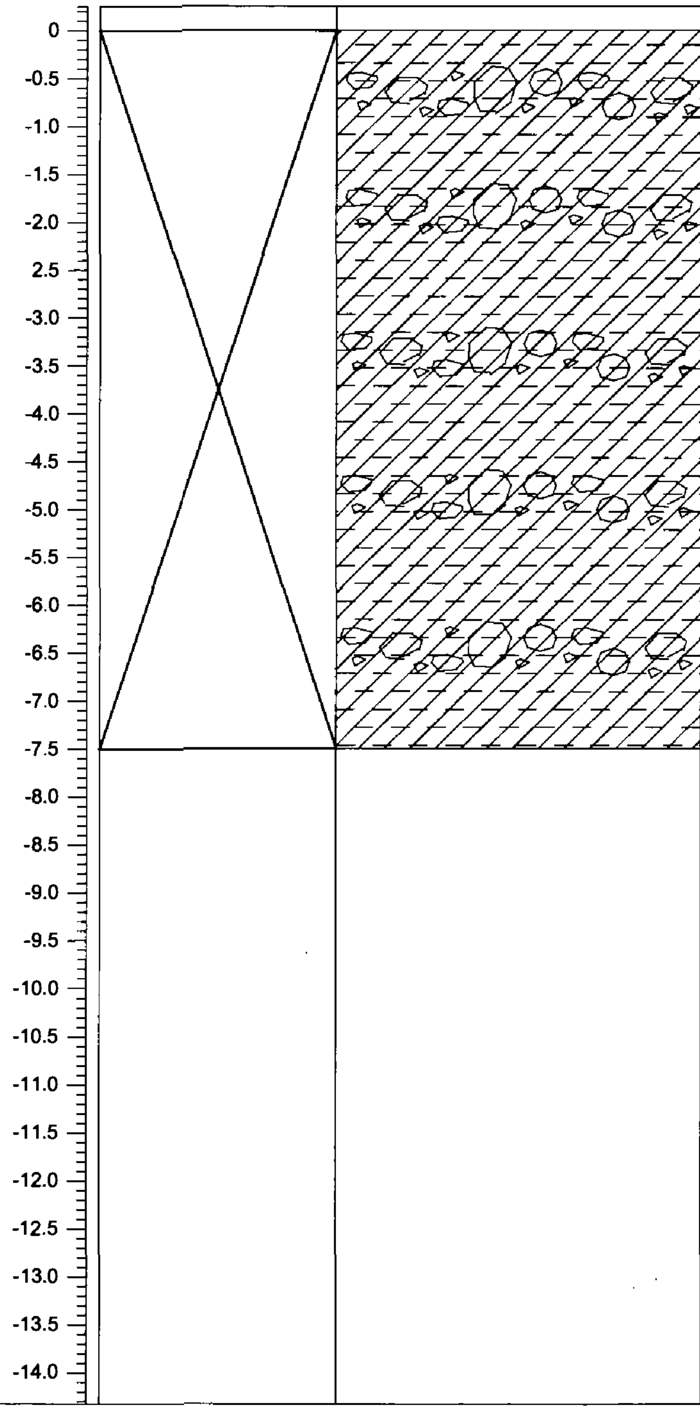
TEST PIT LOG			PAGE 1 OF 1
SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-20	COORDINATES OR LOCATION:	LAT: 37.7064 LON: -108.0298
LOGGED BY: KC CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/14/08 DATE COMPLETED: 10/14/08

DEPTH (FT) | SAMPLE DEPTH INTERVAL | PROFILE | DESCRIPTION



BROWN CLAYEY SILT WITH GRAVEL AND SOME COBBLES (6" - 12" DIAMETER) 5-10% ROCK

LENS OF RED CALCINE TAILINGS @ 3'

TD = 7.5' NOTES: PIECE OF CONCRETE FOUNDATION WITH END OF PIT AT 2' DEEP, METAL DEBRIS FOUND IN ZONE CONTAINING THE CALCINE TAILINGS. TEST PIT BACKFILLED AND COMPACTED. X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-21	COORDINATES OR LOCATION:	LAT: 37.7070 LON: -108.0302
LOGGED BY: KC CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)

DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -2.0	X		BROWN SILTY SAND AND GRAVEL
-2.0 to -3.0	X		WHITE AND YELLOW CRUSHED ROCK, MINE WASTE (3" - 6" DIAMETER) ROCK, 60% ROCK
-3.0 to -7.0	X		BROWN SILTY SAND WITH GRAVEL AND COBBLES 10-15% ROCK
-7.0			TD

TD = 7.0' NOTES: TEST PIT BACKFILLED AND COMPACTED

X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON

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TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-22		COORDINATES OR LOCATION:	LAT: 37.7075 LON: -108.0305
LOGGED BY: KC/CS CHECKED BY: SDA	SURFACE ELEVATION:		GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/13/08 DATE COMPLETED: 10/13/08	

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -1.0	X		CRUSHED STONE AND SOLIDIFIED RED SANDY TAILINGS - CALCINE
-1.0 to -2.0	X		ORANGE SILTY SAND WITH GRAVEL AND COBBLES - MINE WASTE
-2.0 to -5.0	X		BROWN SILTY SAND WITH COBBLES
-5.0			TD

Depth scale: 0, -0.5, -1.0, -1.5, -2.0, 2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

TD = 5.0' NOTES: STEEL PIPE IN TRENCH RUNNING N/S AT 1.2' DEEP. PIPE 9" DIAMETER. TEST PIT BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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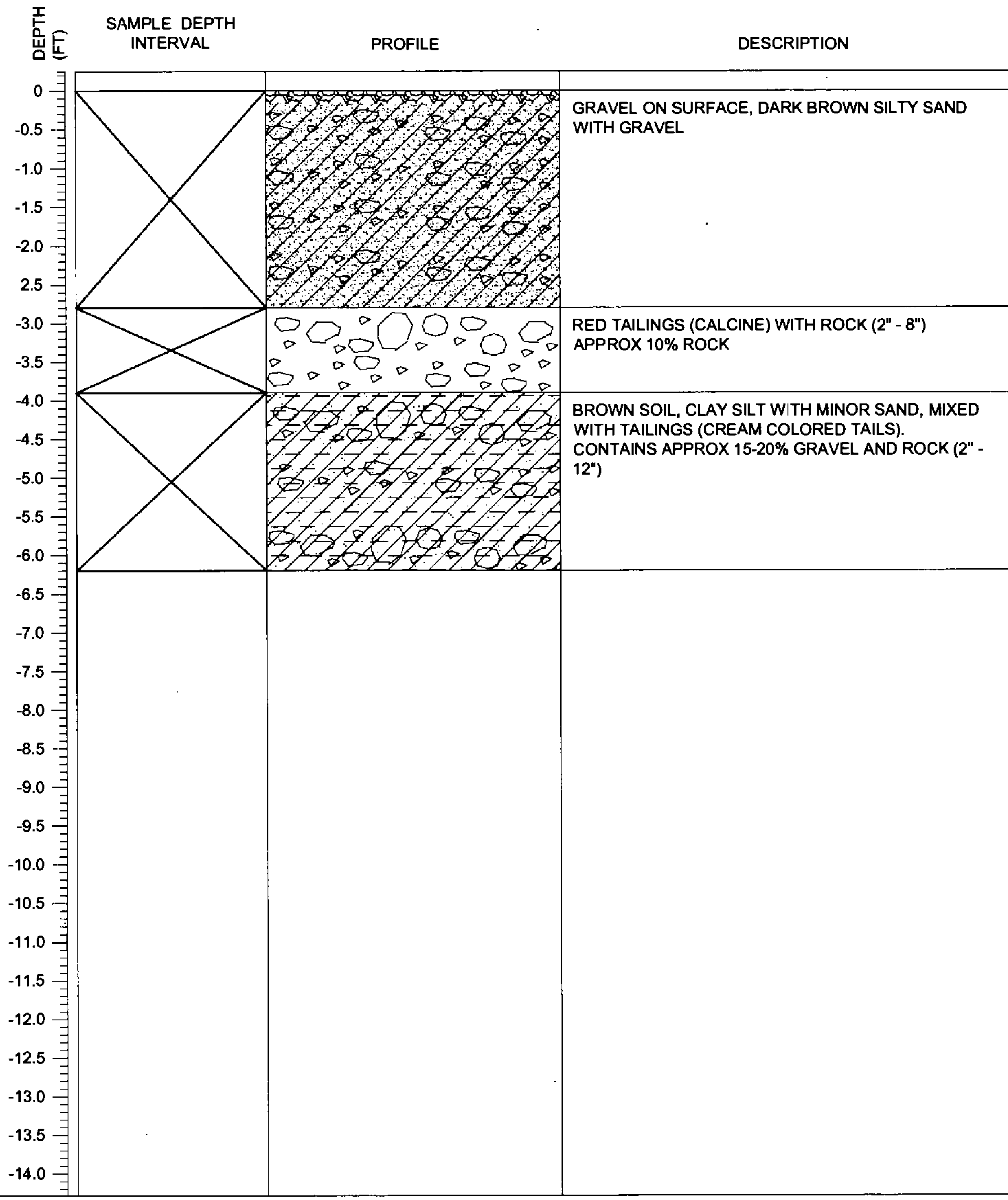
TEST PIT LOG			PAGE 1 OF 1
SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-23	COORDINATES OR LOCATION:	LAT: 37.7079 LON: -108.0312
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A GWL DEPTH:	(ENCOUNTERED) (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT	FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08



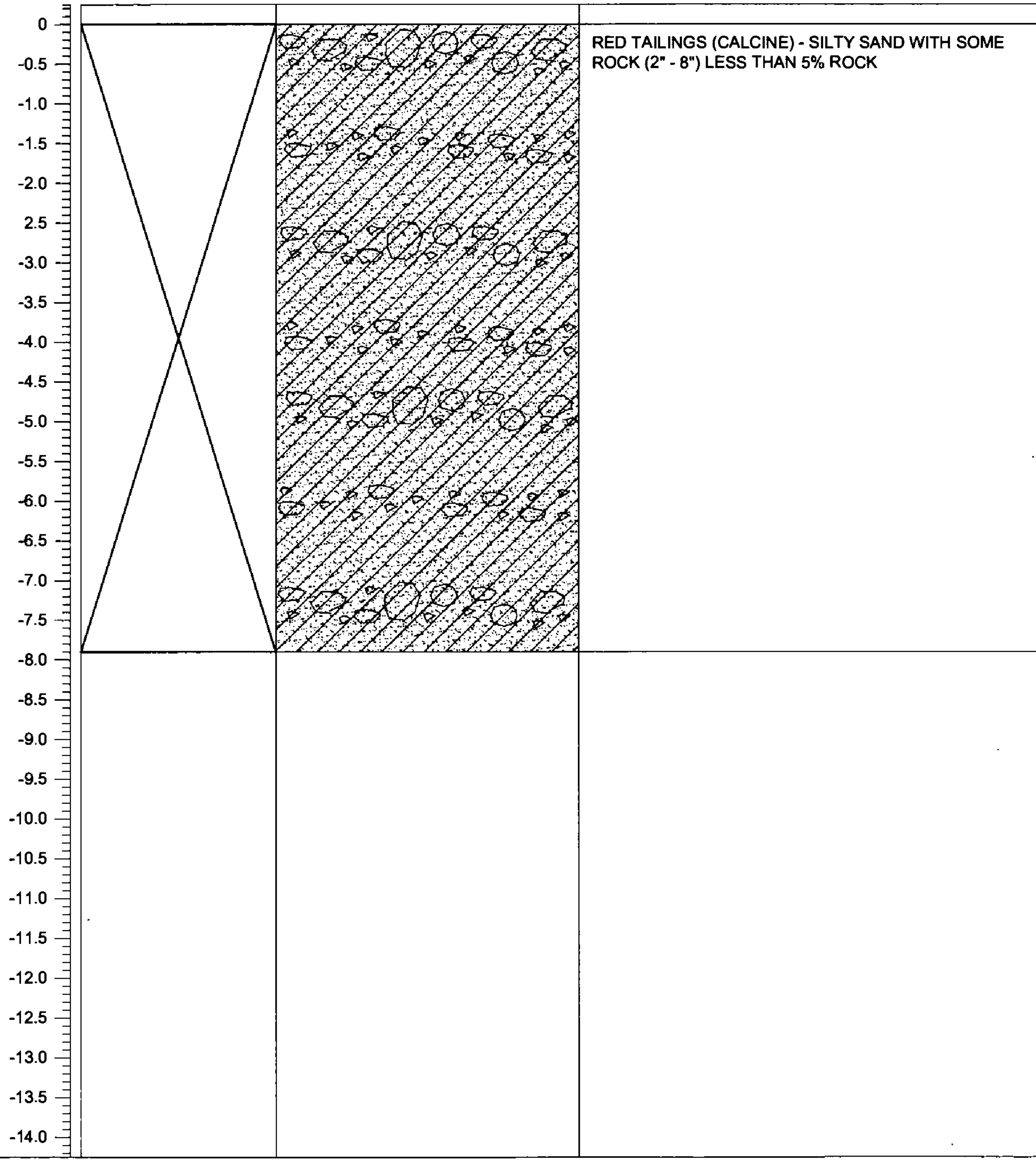
TD = 6.2' NOTES: NO WATER. BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

ANDERSON
ENGINEERING COMPANY, INC.

TEST PIT LOG

SITE NAME: RICO PROJECT: ST LOUIS PONDS	BORING NUMBER: TP-24	COORDINATES OR LOCATION: LAT: 37.7082 LON: -108.0317
LOGGED BY: CS CHECKED BY: SDA	SURFACE ELEVATION:	GWL DEPTH: N/A (ENCOUNTERED) GWL DEPTH: (STATIC)
DRILLING METHOD: BACKHOE TEST PIT	HOLE DIA: PIT / FLUID USED: N/A	DATE STARTED: 10/10/08 DATE COMPLETED: 10/10/08

DEPTH (FT)	SAMPLE DEPTH INTERVAL	PROFILE	DESCRIPTION
0 to -7.9	X		RED TAILINGS (CALCINE) - SILTY SAND WITH SOME ROCK (2" - 8") LESS THAN 5% ROCK



TD = 7.9' NOTES: BACKFILLED AND COMPACTED
X = SAMPLE COLLECTED, COMPOSITE OF MATERIAL

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ENGINEERING COMPANY, INC.

SEH 2004

10:00 AM EXCAVATE TP-2004A
0'- 10.5' CAT 436B RUBB TIRE BACKHOE
COLLUVIUM, CLAYEY SAND AND
GRAVEL, DARK REDDISH GRAY
(3/1), BOULDERS TO 2.0',
MOIST, MODERATELY DENSE
BOULDERS AND COBBLES
SUBROUNDED TO ANGULAR,
ESTIMATE 30% >2"

TP-2004A

TP-2004 B
0 - 7.0' COLLUVIUM
, CLAYEY SAND AND GRAVEL
BROWN (4/3), MOIST, MOD
DENSE, LOW PLASTISITY
FINES, BOULDERS TO 1.0',
COBBLES AND BOULDERS
ANGULAR, TO SUBANGULAR
ESTIMATE 20% > 2"

TP-2004B

TP-2004 C
0 - 5.0' COLLUVIUM
CLAYEY SAND AND GRAVEL
DARK BROWN (3/2), SLIGHTLY
MOIST, FINES LOW TO MOD
PLASTICITY, BOULDERS TO 3.0'
ESTIMATE 15% > 2". COBBLES
ANGULAR TO SUBANGULAR

TP-2004C

TP-2004 D
0.0 - 1.5', TOPSOIL
1.5 - 6.0' COLLUVIUM
SILTY GRAVELLY SAND,
DARK REDDISH BROWN (3/4),
SLIGHTLY MOIST, LOOSE,
BOULDERS TO 1.0', SUBROUNDED
TO SUB ANGULAR. ESTIMATE
5-10% > 2".

TP-2004D

TP-2004 E
N. OF POND 18 IN CALCINE
TAILINGS
0'-9.0' Calcine Tailings
9.0-12.0' RIVER COBBLES
WATER @ 8.0'

TP-2004E

TP-2004 F
EAST OF POND 18
0 - 0.5' FILL
0.5 - 12.0' CALCINE TAILINGS

TP-2004F

TP-2004 G
EAST OF POND 18
0 - 0.5 FILL
0.5 - 12.0' Calcine tailings

TP-2004G

TP-2004 H
POND 16/17
0-4.0' FILL
4.0'-12.0' Calcine tailing
GW@ 11.0'

TP-2004 H

TP-2004 I
POND 16-17
0-12.0' Calcine Tailings
~~GW@~~ GW@ 12.0'

3 SAMPLES EACH PIT

TP-2004I

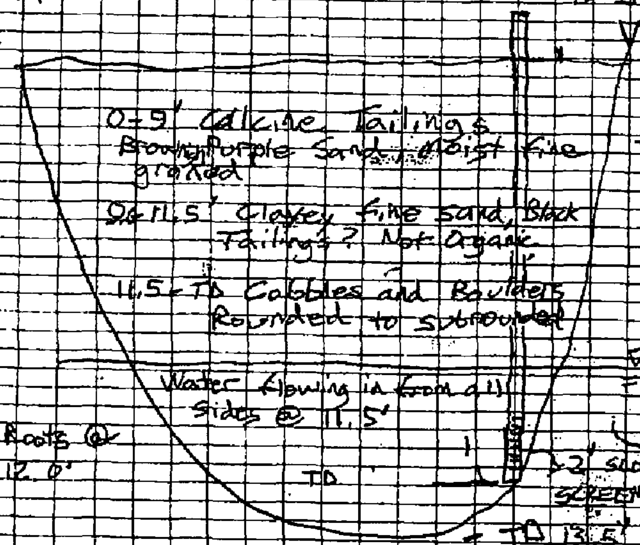
SEH 2001

TP-A

2:35 PM

TP-A ~13 Paces N-NE of Stake 18 D

E W



0-9' Calcine Tailings
Brown/Purple Sand, moist fine grained

9-11.5' Clayey fine sand, Black
Tailings? Not Organic

11.5-TD Cobbles and Boulders
Rounded to subrounded

Water flowing in from all sides @ 11.5'

Large Roots @ 12.0'

TD

TD 13.5'

9.3'

STA	BS	HI	FS
18D	9^{15}		
TOP PIEZO			5^{36}
E.G.			8^{10}

2" PVC CASING

2' SLOTTED SCREEN W/ FILTER SOCK

INITIAL PIEZO LENGTH 21.8'

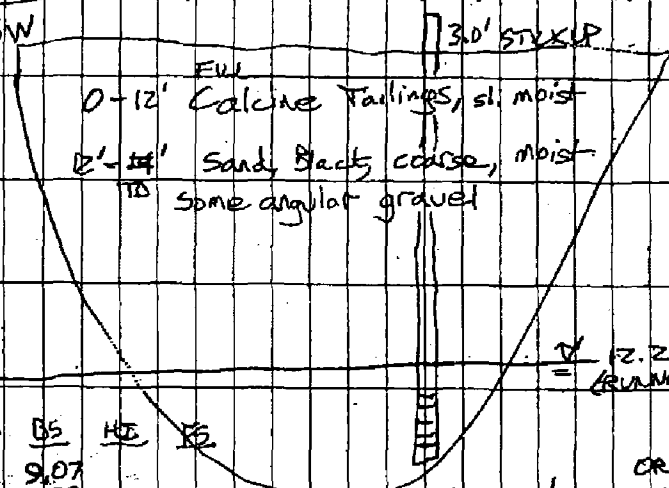
CUT OFF 6.85'

TP-B

3:40 PM TP-B JUST WEST OF SW CORNER TEST CELL #9

SW NE

3.0' STICKUP



FILL

0-12' Calcine Tailings, sl. moist

12'-~~14'~~ TD Sand, Black, coarse, moist
Some angular gravel

12.2' RUNNING IN

TD 16.8'

2" PVC CASING

STA	ELEV.	BS	HI	FS
18-J		9.07		
TOP CASING		~~4.68~~		4^{68}
EX. GND				

ORIG. PIEZO LENGTH 21.8'

CUT OFF 1.95'

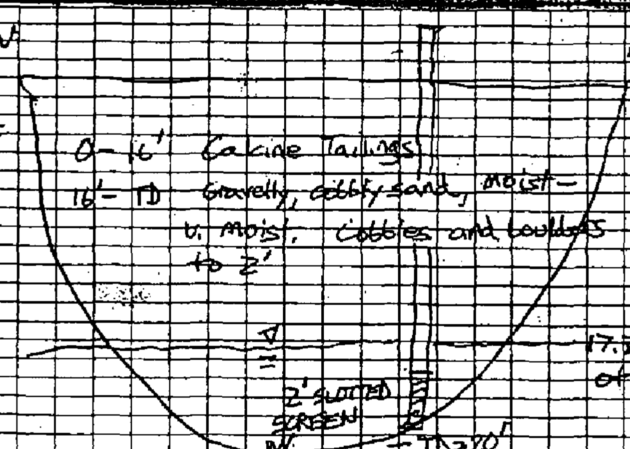
TP-C

4:10 PM

TP-C

54' YARDS DUE EAST OF 18-G HUB
NEAR EDGE OF ROAD
~~[illegible]~~
~20' S. OF LINE THRU 18-A, 18-G

W E



0-16' Calcine Tailings

16'-TD Gravelly, cobbly sand, moist - v. moist, cobbles and boulders to 2'

2" PVC CASING

17.3' from top of casing

2' SLOTTED SCREEN W/ FILTER SOCK

TD=20'

STA	ELEV	BS	HI	FS
18-G		3^{57}		
TOP CASING				2^{50}
Ex. GND				5^{20}

INITIAL CASING LENGTH 28.3'

CUT OFF 5.13'

ANDERSON Engineering Company, Inc.
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Salt Lake City, Utah 84119
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ARCO

RICO RECLAMATION

BORROW MATERIAL

BORING NO. APB-1

SHEET 1 OF 1

DATE STARTED: 10 APR 96

DATE COMPLETE: 10 APR 96

TOTAL DEPTH: 3.0

SURFACE ELEV: 8885

X: N 26680   Y: E. 20135

SAMPLING METHOD: BACKHOE PIT

LOGGED BY: JOEL MARTINEAU

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
		0			SURFACE HAS ROCKS EXPOSED
APB-1				SC-CL OH -GW	0-0.7 Root ZONE SOIL GRAYISH BROWN SANDY-clay to clay w/ ORGANIC MATERIAL AND MINOR GRAVEL TO 1CM SIZE. Some Large Rock Sizes, Scattered.
	0-3'	1			0.8-3.0 FT Brown Soil w/ Isolated Sub-rounded rock Texture SC-CL. EST 5% Rock > 3". Rock Fragments To 4 CM, Subangular.
		2			
		3			

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SAMPLING METHOD: BACKHOE

LOGGED BY: J. MARTINEAU

ARCO

RICO RECLAMATION

BORROW MATERIAL

BORING NO. APB-2
SHEET 1 OF 1
DATE STARTED: 10 APR 1996
DATE COMPLETE: 10 APR 1996
TOTAL DEPTH: 3.0'
SURFACE ELEV: 8853
N 26710 E 19940

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
APB-2	0-3'	0		SM-CL + GW	0-1.0' Root ZONE NO NOTICABLE ORGANICS Color Reddish-BROWN TO Yellow-BROWN. (Limonitic + Hematitic) FINES SANDY SILT AND CLAY Rocks Mostly Sub-angular
		1		SM-CL + GW	1.0' – 3.0' SIMILAR TO ABOVE LARGER Rock INCREASING Percentage Largest size 1.5 × 1.2 × 1.7 Two others OVER 1' Screen SIZE
		2			
		3			

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SAMPLING METHOD: Backhoe

LOGGED BY: J. MARTINEAU

ARCO

RICO RECLAMATION

BORROW MATERIAL

BORING NO. APB-3
SHEET 1 OF 1
DATE STARTED: 10 APR 96
DATE COMPLETE: 10 APR 96
TOTAL DEPTH: 3.0
SURFACE ELEV: 8836
N 26400 E 20000

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
		0			
APB-3				GW-SC-CL	NO NOTICABLE ORGANIC HORIZON
	0-3'	1			BROWN Soil-Rock Mixture Subangular Rock - consistent gradation from Top to Bottom. (GROUND FROZEN TO 2.5 Ft)
		2			
					Bottom 3" Water
		3			

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ARCO

RICO RECLAMATION

BORROW MATERIAL

BORING NO. PPB-4
SHEET 1 OF 1
DATE STARTED: 10 APR 96
DATE COMPLETE: 10 APR 96
TOTAL DEPTH: 3.0 ft
SURFACE ELEV: 8828
~~X~~: E 19870 ~~Y~~: N 26475

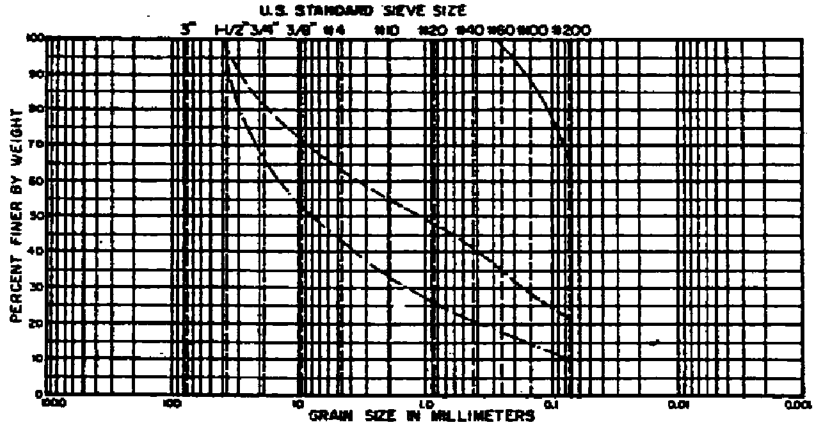
SAMPLING METHOD: BACKHOE
VISUAL ONLY

LOGGED BY: J MARTINEAU

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
		0	o		Water level - sits in River Gravels
NONE TAKEN VISUAL ONLY	N/A	1		GW-GP	mostly sand & gravel. No soil Horizons Fines About 45-50% 3-12" Rock 45% >12" 3-5% This Material consists mostly of Rounded Rock & River Gravel; SANDY FINES
		2			
		3			

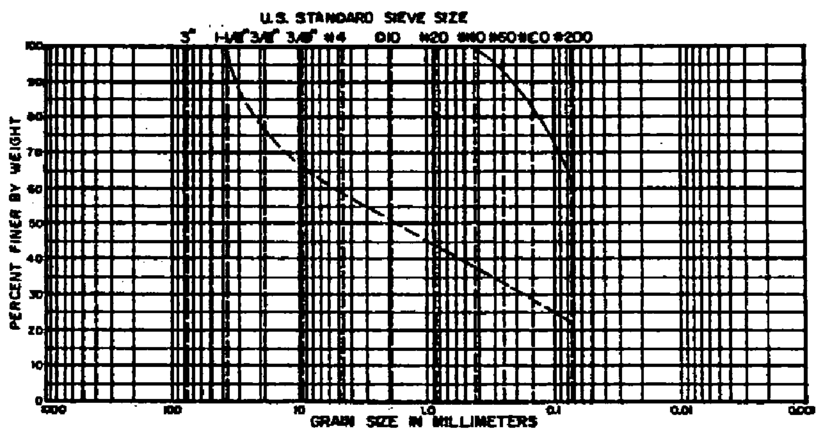
Geotechnical Data

- Dames and Moore, 1981
- Potential Borrow Sources Geotechnical Properties
- Potential Borrow Sources Agronomic Properties



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

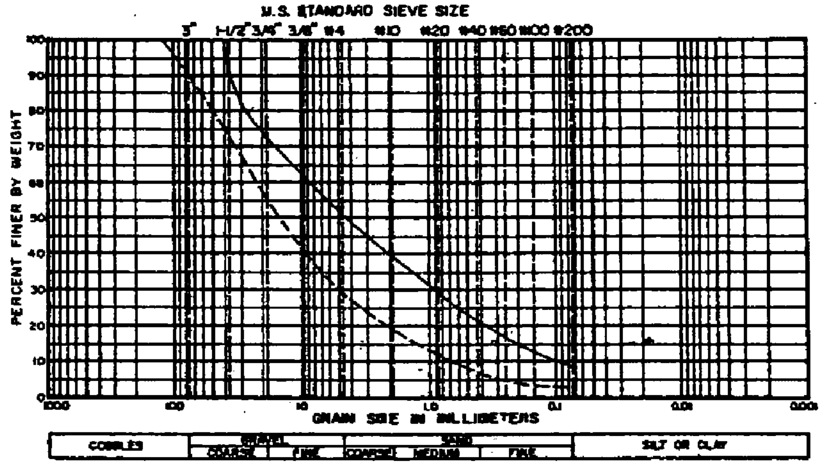
LOCATION	DEPTH	CLASSIFICATION	KEY
~~B-9~~	~~19.5 Feet~~	~~[illegible]~~	————
B-8	9.5 Feet	Yellow and Brown Fine to Coarse Clayey Sand With Some Gravel (SC)	– – – –
B-5	9.5 Feet	Brown Sandy Fine Gravel With Clay (SM)	—— - —— -



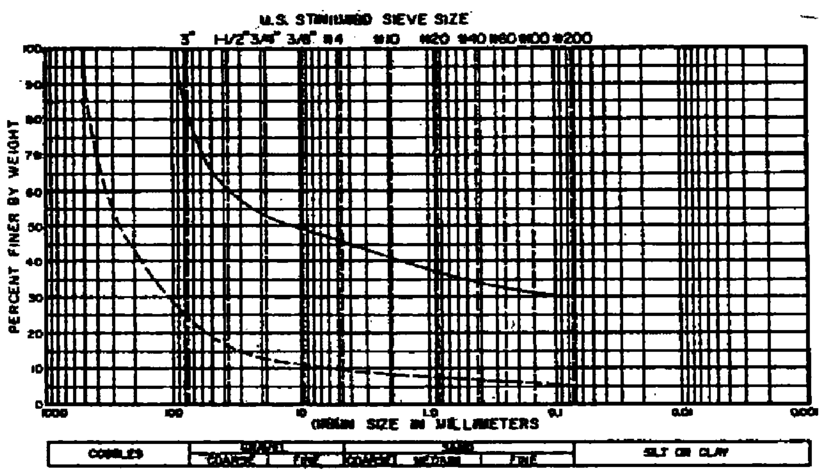
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LOCATION	DEPTH	CLASSIFICATION	KEY
~~B-11~~	~~20 Feet~~	~~[illegible]~~	————
B-4	9.5 Feet	Brown Fine to Coarse Clayey Sand With Gravel (SM-SC)	– – – –

GRADATION CURVES



LOCATION	DEPTH	CLASSIFICATION	KEY
St. Louis Adit Borrow	From Cut Above Adit	Brown to Lt. Brown Sandy Fine [illegible] Gravelly Fine to Coarse Sand With Silt (GW-SM)	————
~~Near Boring B-13~~	~~0 to 1 Feet~~	~~[illegible] Sand (GW)~~	– – – –



LOCATION	DEPTH	CLASSIFICATION	KEY
Dolores River	River Bank	Brown Silty Clayey Fine to Coarse Gravel With Cobbles (GM-GC)	————
Dolores River	River Bed	Sandy Gravel and Cobbles (GP)	– – – –

GRADATION CURVES

SAMPLE NO. — DEPTH — ELEVATION —

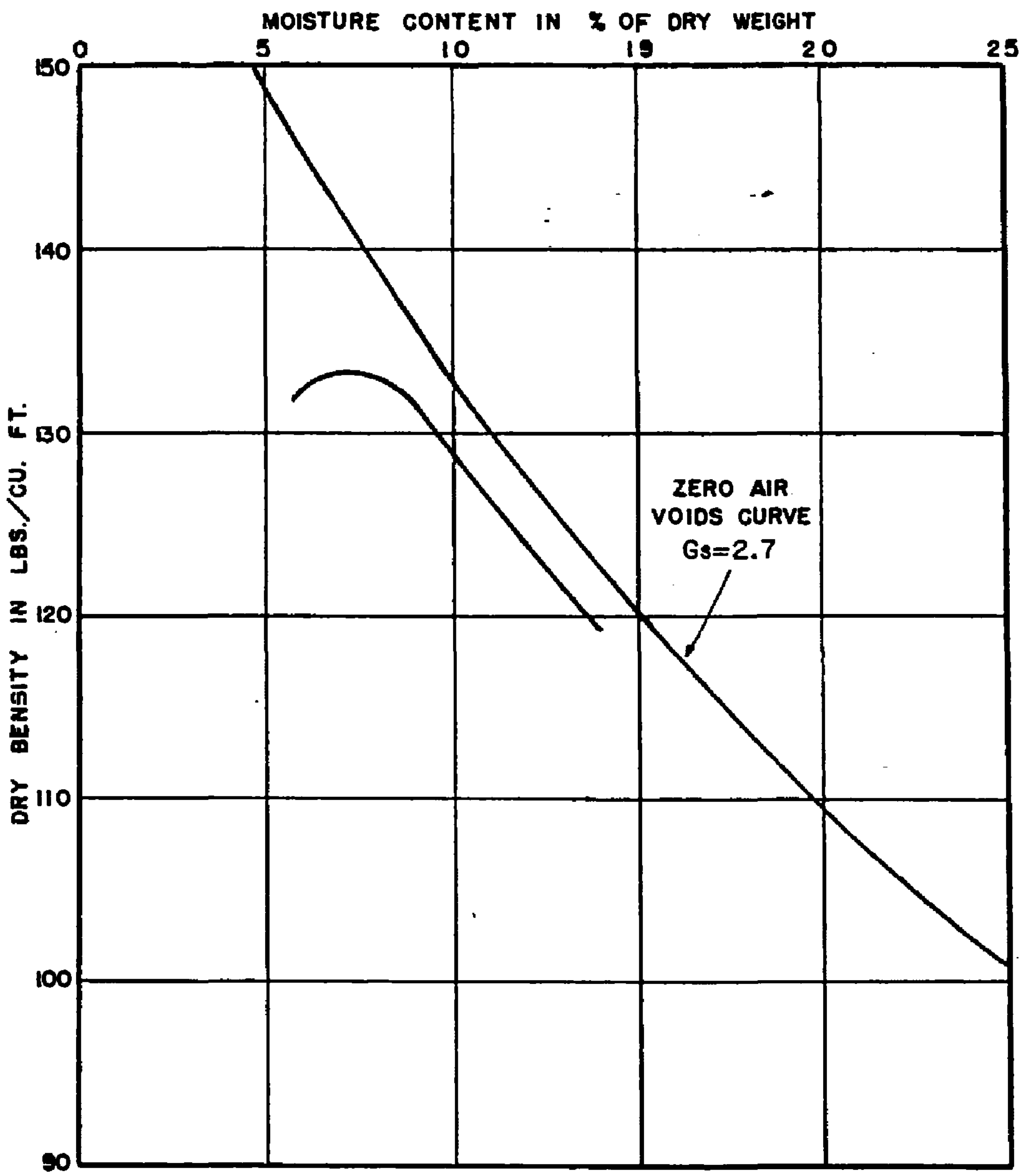
SOIL Sandy Gravel and Gravelly Sand (GM-SM)

LOCATION Cut Above St. Louis Adit

OPTIMUM MOISTURE CONTENT 7.5 Percent

MAXIMUM DRY DENSITY 133 Pounds Per Cubic Foot

METHOD OF COMPACTION ASTM D-1557 Method C



COMPACTION TEST DATA

DAMES & MOORE

CHECKED BY ____ DATE ____

BY ____ DATE ____

BY ____ DATE ____

04010-082-1605

58,1 (REV. 4-57)

PLATE A-5A

SAMPLE NO. – DEPTH – ELEVATION –

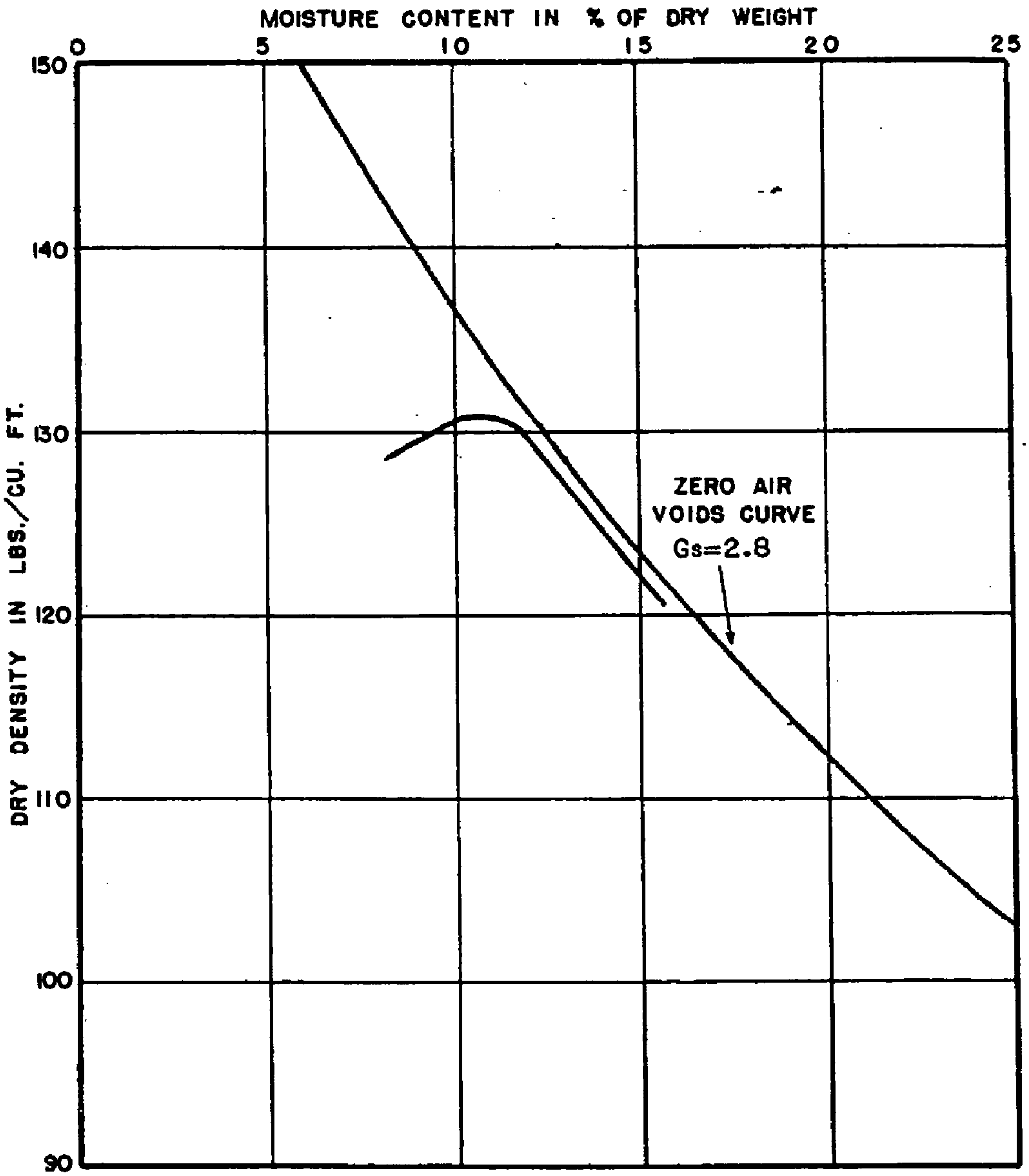
SOIL Brown Silty Clayey Gravel (GM-GC)

LOCATION Dolores River Bank Material

OPTIMUM MOISTURE CONTENT 11 Percent

MAXIMUM DRY DENSITY 131 Pounds Per Cubic Foot

METHOD OF COMPACTION ASTM D-1557 Method C



COMPACTION TEST DATA

DAMES & MOORE

156.1 (REV. 4-57)

FILE 04010-082-1605

CHECKED BY ____ DATE ____

Potential Borrow Sources Geotechnical Properties

Sieve	GRADATION (cumulative percent passing) Sample ID: St. Louis Ponds Site Sources TP20004A-1	TP20004A-2	TP20004B	TP20004C	TP20004D	Off-Site Sources: Line Camp Pit	Hay Camp Pit	Mountain Stone Pit - Top Soil	Mountain Stone Pit - 3/4"
4"	88	82	100	100	100	100	100	100	82
3"	88	80	97	97	100	100	100	100	80
2.5"	81	79	94	89	100	100	100	100	79
2"	80	75	92	87	98	100	100	100	75
1.5"	73	69	85	82	92	100	100	100	69
1"	63	62	72	76	89	100	100	100	62
3/4"	60	58	64	72	85	98	100	100	58
1/2"	53	49	53	65	79	96	99	100	49
3/8"	49	46	46	60	77	95	99	100	46
#4	41	38	36	54	68	90	99	99	38
#8	34	30	29	46	62	87	98	98	30
#16	28	24	25	42	56	85	98	95	24
#30	23	20	22	36	50	80	97	92	20
#40	21	17	21	32	46	76	96	91	17
#50	18	15	18	29	40	68	95	88	15
#100	14	12	14	24	28	47	93	75	12
#200	13	10	12	22	24	36	85	65	10

Index Value (%)	ATTERBERG LIMITS: TP20004A-1	TP20004A-2	TP20004B	TP20004C	TP20004D	Line Camp Pit	Hay Camp Pit	Mountain Stone Pit - Top Soil	Mountain Stone Pit - 3/4"
Liquid limit	26	28	31	26	21	21	28	29	no LL
Plastic Limit	18	18	20	18	17	18	20	19	no PL
Plasticity Index	8	8	11	8	4	3	8	10	non plastic
Moisture Content	14.9	12.4	13.8	11.8	9.2	14.9	4.1	12.1	4.7

POTENTIAL BORROW SOURCES AGRONOMIC PROPERTIES

Sample ID	Agronomic Data: EC as mmho/cm	N -ppm as NOS	Bicarb P -ppm as P	Bray Weak P -ppm as P	K -ppm as K	pH as units	Organic Matter as %	CEC meq/100	Saturation Percent	Saturated Paste Extract: Mg Meq/L	Saturated Paste Extract: Ca Meq/L	Saturated Paste Extract: Na Meq/L	SAR	Mg as ppm	Ca as ppm	CaCO3 as %	T - S as %	Neutralization Potential Tn/1000Tn	Acid Potential Tn/1000Tn	Acid-Base Potential Tn/1000Tn
St. Louis Ponds Site Sources																				
TP2004 4A-a		1	2		78	6.9	1.2	17.1						232	2992	0.825	0.197	8.25	6.15	2.10
TP2004 4A-b		1	4		70	7.5	1.0	13.4						191	2332	1.08	0.041	10.80	1.28	9.53
TP2004 4B		1	1		54	8.1	0.6	16.0						190	2851	3.286	0.036	32.90	1.13	31.70
TP2004 4C		1	2		72	7.8	1.0	10.8						94	1957	0.365	0.015	3.65	0.48	3.16
TP2004 4D		2	1		69	7.9	1.3	11.0						89	2023	2.212	0.048	22.10	1.50	20.60
Off-Site Sources																				
Line Camp Pit - Top Soil		8	1		68	7.7	1.3	8.0						117	1378	1.541	0.068	15.40	2.14	13.30
Line Camp Pit (earlier sample)					151	7.6	2.1	10.7						187	1752					
Hay Camp Pit	0.34	6		26	304	6.7	2.4	14.2	43.7	0.72	2.41	0.57	0.45	314	2152	0.117	0.021	1.17	0.66	0.51
Hay Camp Pit (earlier sample)					270	7.1	3.3	12.3						246	1910					
Mountain Stone Pit - Top Soil	1.76	91	5		111	7.5	1.9	16.1	49.3	3.85	13.8	1.38	0.47	253	2740	1.336	0.019	13.4	0.59	12.8
Mountain Stone Pit - 3/4"	0.31	1	3		72	8.3	0.5	9.2	23.5	0.48	2.25	0.95	0.82	78	1670	1.847	0.038	18.5	1.18	17.3

Sample ID	USDA Textural Data (see note): Percent Sand	Percent Silt	Percent Clay	USDA Class	Percent Course Fragments	Total Soil Metals Data (Nitric Acid Digest) (mg/kg): B	Cd	Cu	Fe	Pb	Mn	Mo	Zn	Plant Available Soil Metals Data (Bicarb DTPA) (mg/kg): B	Cu	Fe	Mn	Zn
St. Louis Ponds Site Sources																		
TP2004 4A-a	68.8	18.8	12.5	silty loam	36.0	49.4	8.4	48.4	22100	187	1250	<1.0	230					
TP2004 4A-b	70.0	16.3	13.8	silty loam	36.0	46.9	7.6	38.6	21200	60.1	1110	<1.0	161					
TP2004 48	63.8	18.8	17.5	silty loam	47.0	64	11.8	47.0	30800	116	1720	3.2	240					
TP2004 4C	65.0	18.8	16.3	silty loam	13.0	20.1	2.8	15.5	7780	23.5	353	<1.0	45.4					
TP2004 4D	66.3	18.8	15.0	silty loam	22.5	43.4	7.0	54.7	17500	328	837	4.3	246					
Off-Site Sources																		
Line Camp Pit - Top Soil	60.0	21.3	18.8	silty loam	31.0	65.3	15.4	117	30800	613	2130	3.6	920					
Line Camp Pit (earlier sample)														0.6	2	41	11	3.2
Hay Camp Pit	46.3	31.3	22.5	loam	<2.0	NT	3.4	NT	NT	12	NT	<1.0	NT					
Hay Camp Pit (earlier sample)														0.7	1.5	38	17	2.3
Mountain Stone Pit - Top Soil	46.3	32.5	21.3	loam	0.0	29.1	2.7	14.8	7970	12.5	384	<1.0	46.1					
Mountain Stone Pit - 3/4"	87.5	8.8	3.8	loamy Sand	80.4	31.8	3.5	160	11100	15.8	459	<1.0	136					

Note: USDA Textural Data was determined on samples that had been screened to remove material over 3/4"

Attachment 3

ATTACHMENT 3

Removal Action Work Plan
Rico-Argentine Site – Rico Tunnels OU1

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS ("ARARS")

I. SOLID WASTE MANAGEMENT AND DISPOSAL REQUIREMENTS

A. Certificate of Designation (C.R.S. § 30-20-102; 6 CCR 1007-2 § 1.3.3). Colorado law requires that any person who owns or operates a solid waste disposal site and facility must obtain a Certificate of Designation ("COD") from the county or municipality in which such site or facility is to be located, and prohibits anyone from disposing of solid waste except at a solid waste disposal site or facility holding a COD. C.R.S. 30-20-102. The local government having jurisdiction approves and issues the COD only upon a recommendation of approval from Colorado Department of Public Health and Environment ("CDPHE"). Solid waste sites and facilities regulations promulgated by the CDPHE Hazardous Materials and Waste Management Division ("HMWMD") in 6 CCR 1007-2 provide that no person shall operate a solid waste disposal site or facility without a COD obtained from the county or incorporated municipality (which in this case would be Dolores County), subject to certain statutory exemptions (C.R.S. § 30-20-102; §§ 1.3.3 and 1.4), However, even solid waste disposal sites or facilities exempted from COD requirements must comply with the applicable minimum standards set forth in § 2.0 of HMWMD regulations (§ 1.3.7.).

The COD requirements apply to new "solid waste disposal sites or facilities," defined as the location and/or facility at which "the deposit and final treatment of solid wastes occur." C.R.S. § 30-20-101(8); 6 CCR 1007-2 §§1.2. "Solid waste disposal" is defined as "the storage, treatment, utilization, processing or final disposal of solid wastes." § 30-20-101(7); § 1.2. New solid waste disposal sites and facilities also must comply with HMWMD's regulations, including the standards set forth in those regulations, unless CDPHE waives compliance with specific standards (§§ 1.3.4 and 1.3.5). In addition, the construction, operation and closure of all new facilities must comply with designs, specifications and procedures outlined in approved COD application, as well as with local requirements (§ 1.3.5). Existing solid waste disposal sites and facilities are subject to the § 2.0 minimum standards of the regulations.

The proposed St. Louis Tunnel water treatment system will utilize (aside from the lime-treatment plant) existing settling ponds in the water flow management and solids settling process, newly-constructed onsite drying facilities ("drying facilities") for dewatering and consolidation of solids removed from the settling ponds, and a newly-constructed repository ("solids repository") for final and permanent disposal of solids generated by the water treatment system.

The settling ponds and drying facilities are not permanent solid waste disposal sites or facilities, and therefore, are not subject to COD requirements. The solids repository is a solid waste disposal facility that would be subject to the COD requirements. The solids repository will be designed and operated in conformity with applicable HMWMD regulations and standards.

The solids repository will be located exclusively on private lands owned by the NorthRico Trust. NorthRico, Inc. ("NorthRico"), a Colorado non-profit entity of which Atlantic Richfield Company is a Member, serves as trustee for the NorthRico Trust. An application for issuance of a COD from Dolores County will be prepared and the necessary approvals sought from the County and CDPHE for location and construction of the solids repository.

B. Financial Assurance (§ 1.8). Any owner or operator of a new or existing solid waste disposal site/facility is required to establish and maintain financial assurance sufficient to ensure payment of costs for closure and post-closure care of the site/facility. Section § 1.8.4(A) and C.R.S. 30-20-104.5(3)(a) provide that "[n]o solid waste disposal site/facility shall operate without being in compliance with the financial assurance requirements." All owners/operators must show proof of sufficiency of financial assurance (§ 1.8.2). The financial mechanisms available under HMWMD regulations are the same as those mechanisms allowed under EPA regulations promulgated under the Resource Conservation and Recovery Act (RCRA), 40 C.F.R. 264.146), but also include other mechanisms approved by CDPHE .

Atlantic Richfield will establish and maintain financial assurance required under the regulations for closure and post-closure of the drying bed and solids repository. The appropriate financial assurance amounts and mechanism will be determined in conjunction with the COD application, and as approved by CDPHE.

C. Section 2.0 Minimum Standards. These minimum standards apply to all solid waste disposal sites and facilities, and are intended to be used in conjunction with all other sections in the regulations (§§ 1.3.11(A) and 2.1).

The § 2.0 minimum standards are relevant to the solids repository, and satisfaction of such standards are discussed more fully below.

D. General Recuirements. Pursuant to C.R.S. § 30-20-110(1)(b) and 6 CCR 1007-2 § 2.1.1, all solid waste disposal sites/facilities must comply with CDPHE, Water Quality Control Commission ("WQCC"), and Air Quality Control Commission ("AQCC") health laws, standards, rules and regulations, and all applicable local zoning laws and regulations.

The following sections summarize how design under the Removal Action, and the future construction and operation of the St. Louis water treatment system will satisfy all applicable state laws, standards, rules, regulations and local requirements. As part of the Removal Action, 30% designs for the adit hydraulic control structure and treatment system will be prepared to address these requirements. Compliance with the environmental covenant requirements imposed under C.R.S. § 25-15-320(2) for "environmental remediation projects" is also a requirement for location of any new solids repository on the site.

E. Nuisance conditions. Such conditions, including noise, dust, odors, and conditions attracting pests are not permitted to exist at or beyond the site boundaries (§ 2.1.3). Measures also must be implemented at the repositories to control debris and public access (§§ 2.1.7 and 2.1.8), and prevent water ponding and erosion (§ 2.1.10).

Compliance with the COD, the Land Development Agreement entered into with Dolores County with CDPHE's recommended approval, and general Dolores County nuisance control requirements contained in the County Land Use regulation will ensure control and prevention of nuisance conditions at or beyond the site boundary.

F. Point of Compliance (§ 2.1.4). Water pollution shall not occur at or beyond the Point of Compliance ("POC"). In addition, § 2.1.15 provides that solid waste disposal sites/facilities must comply with the ground water protection standards at the relevant POC as defined in § 1.2, and that the owner/operator shall make a demonstration of compliance. "Water pollution" means manmade or man-induced alteration of the background physical, chemical, biological or radiological integrity of ground water or surface water. "Point of compliance", as pertaining to solid waste disposal sites/facilities that are not landfills, must be located on land owned by the site or facility owner, and is defined as a vertical surface at the perimeter of the solid waste disposal site/facility boundary. "Site boundary" is the outmost perimeter of the site or facility (§ 1.2).

The proposed water treatment system will not result in water pollution occurring at or beyond the POC for this site, or impairment of ground water at the POC. The identification of groundwater quality standards for the site is discussed further in Section II.A of this Attachment 3.

The treatment system will be designed to protect existing water quality of the Dolores River by meeting effluent discharge limitations and other requirements set forth in the CDPS Industrial Individual Wastewater Discharge Permit that Atlantic Richfield applied for in August 2010 ("CDPS discharge permit") for discharges from the pond system to the River. Moreover, incidental precipitation accumulating on the drying bed / repository surfaces will be controlled, and likely directed to the treatment system. Leachate from the repository will be captured and conveyed by pipeline to the water treatment system. Runon-runoff controls will also be implemented for any new solids repository to meet storm water management requirements set forth in § 2.1.6.

Pond 1 is the most downstream pond area at the site. The proposed groundwater POC for this site would be established at a location just downstream of Pond 1 where groundwater discharges from the alluvial aquifer beneath the ponds to the Dolores River. Consistent with the definition of "point of compliance," this proposed point will be located on property that is owned or controlled by the NorthRico Trust, and at the perimeter of the site boundary. Ground water quality at this POC will not be impaired and will meet the standards that are identified under the regulatory protocol described in Section II.A.

A layer of fine sediment and precipitates (including settled lime solids) will remain in each settling pond to minimize seepage through the pond bottom. Based on mass balance analyses (described in Attachment 2), ground water reaching the Dolores River from the site is not expected to result in a measurable exceedance of any surface water quality standard applicable to this segment of the Dolores River.

G. Significant Aquifer Recharge Areas (§ 2.1.5). No significant aquifer recharge areas, as designated by the State Engineer's Office ("SEO") or WQCC, shall be adversely impacted by solid waste disposal.

The SEO and WQCC have not designated the ponds system vicinity as a significant aquifer recharge area to date. In addition, lime treatment will reduce the concentrations of dissolved metals in the minor seepage from the pond bottoms to ground water. Thus, system operations will not adversely impact current ground water quality to the point of exceeding applicable groundwater standards.

H. Placement of Waste into Ground Water (§ 2.1.17). On or after the effective date of the regulations, placement of solid wastes below or into surface or ground water is prohibited.

Operation of the solids repository will not adversely impact ground and surface water, as the newly constructed repository will be constructed with a liner above the water table. Therefore, solids deposited in the repository will not be placed below or into surface or ground water, nor will seepage from the repository reach the shallow aquifer.

The depth to groundwater in the alluvial aquifer is shallow, and the settling ponds may seasonally intercept groundwater. During the period of water treatment system operations, accumulated solids in each of the settling ponds will be periodically removed (leaving a layer of solids in the pond bottom), transported to the drying facility and later transferred to the solids repository. Should the use of the settling ponds for water treatment system operations cease in the future, residual solids in each settling pond would at that time be removed, dried and placed in the solids repository prior to final closure of the repository.

I. Ground Water Monitoring (§ 2.2.1 and Appendix B). Applicable ground water monitoring requirements in absence of a waiver received pursuant to § 1.5. Under these requirements, a monitoring system must be installed at appropriate locations and depths that provide samples representing the background ground water quality and ground water quality at the relevant POC (as defined in § 1.2 and specified in § 2.1.15).

Following completion of the Removal Action as part of the final design for the treatment system, an integrated ground and surface water monitoring plan will be developed for the site for agency review and approval. Monitoring in accordance with the CDPS discharge permit will partially or fully satisfy this requirement.

J. Closure and Post-Closure (§§ 2.5 and 2.6). In addition to procedural requirements applicable to closure and post-closure activities, (e.g., written closure plans), § 2.5 prohibits water pollution at or beyond the POC after closure, and nuisance conditions at or beyond the site boundary after closure. The post-closure care period is at least 30 years in duration (§ 2.6.2). In addition, § 2.1.10 provides that sites/facilities for final disposal must provide adequate cover as described in § 3.3.5 to prevent ponding of water, erosion, and water pollution. Specific closure and cap design requirements for waste impoundments are identified in the discussion of § 9.10 below.

As discussed in subpart F above, the ponds system is not expected to cause water pollution (i.e., manmade or man-induced alteration of the background physical, chemical, biological or radiological integrity of ground water or surface water) beyond the proposed POC, and the pond system will result in compliance with ground water protection standards at the POC. Atlantic Richfield's cap for the solids repository will meet the final cover requirements under this section.

K. Section 9.0 Waste Impoundments. This section covers waste impoundments that store, treat or dispose of liquid, semi-solid or solid wastes. A "waste impoundment" is defined as follows:

> [A] facility or part of a facility that is a natural topographic depression, excavation, pit, pond, lagoon, trench, or diked area. An impoundment, which may be lined with earthen material or synthetic material, is designed for storage, treatment or

final disposal of solid waste. Examples of impoundments are holding, storage, settling, and aeration pits, ponds, and lagoons (§ 1.2).

The settling ponds through which treated waters are circulated in the future treatment system will be Class III waste impoundments (as explained in Paragraph I.N below), and subject to design, closure and post-closure requirements for such class of waste impoundments. The interim and permanent solids drying facilities will both be operated as temporary staging areas for the handling of solids, and are not subject to the regulatory requirements applicable to a waste impoundment.

L. Exempted Existing Facilities (§ 9.1.4). The Section 9.0 requirements do not apply to facilities in operation prior to adoption of the Section 9.0 regulations (January 30, 1994). However, CDPHE, after consultation with the relevant county or municipality, may require the facility to come into compliance with the regulations if CDPHE determines that such a waste impoundment is causing impairment of existing or future use of surface or ground water, or if the waste impoundment is expanded, added to, or modified.

All the settling ponds were in place when the § 9.0 regulations were adopted and, therefore, are "existing" facilities exempted from § 9.0. The settling ponds that are utilized in the future treatment system operations will be upgraded structurally to meet applicable State Engineer's Office dam construction and safety requirements. However, the function and method of operation of these ponds remains unchanged from historic operations.

M. Monitoring (§§ 9.1.5 and 9.8). CDPHE may require surface and ground water monitoring at existing Class III sites where seepage from an impoundment and impairment of existing or future surface or ground water use are determined to be probable.

Impairment of the surface and ground water is not probable because seepage from the unlined ponds will not degrade surface water quality, and seepage to ground water will not degrade ground water quality as compared with historic (existing) conditions. See Paragraph I.F above and Attachment 2 to Work Plan. Liquids derived from operations of the permanent drying facility and the solids repository will be collected and managed in the water treatment system. An integrated surface and ground water monitoring plan will be developed before water treatment operations commence.

N. Impoundments Classification (§ 9.2.1). Permitted waste impoundments are classified for purposes of setting design requirements, depending on: 1) the potential of the site as an aquifer recharge area; 2) the quality of water in the highest aquifer according to 12 parameters;[1] 3) existing or future uses of surface or ground water that could be impaired by impoundment seepage, and 4) the constituents, toxicity, mobility and persistence of the waste. For a Class III impoundment, no liner is required because it is located (A) outside a recharge area for an underground source of drinking water or in an area where no saturated zone exists between the surface and continuous strata of competent bedrock with an in-situ permeability of 1×10^{-6} cm/sec or less and minimum thickness of 50 feet, OR (B) located above an aquifer where impairment of existing or future use of ground water will not occur due to unrestricted seepage of the waste (§ 9.2.4).

[1] These 12 parameters are TDS, TOC, TOH, pH, phenolic compounds, chloride, iron, lead, potassium, sodium, calcium, and sulfate and all other known or probable waste constituents that will be contained in the impoundment.

The settling ponds that are part of the treatment system are Class III waste impoundments for the following reasons: First, ground water at the site is not an underground source of drinking water (i.e., it does not supply a public water system), nor is the site located in the recharge area for a source of underground drinking water. The Town's public water currently is supplied by surface diversion located up Silver Creek, and the Town has filed on water rights for a new underground drinking water source (the North Rico Well Field) to be located approximately two miles upstream of the from the ponds system. Also, there are no private drinking water wells of record completed into the local alluvial aquifer at the ponds site. Further, the ground water currently does not have a classified use under WQCC ground water regulations (see analysis of ground water requirements in Part II below). Second, even though occurring above the alluvial aquifer, seepage from the unlined ponds will not impair existing or future use of the ground water, as more fully explained in Paragraph I.F above and Attachment 2 to Work Plan.

O. Design and Operation Standards (§§ 9.5 and 9.7). These regulations require that all impoundments be designed to perform as classified, and operated in accordance with the standards set forth in § 9.7.

The settling ponds that are rehabilitated for use in the treatment system will be designed and operated to meet the standards applicable to Class ill waste impoundments.

P. Closure and Final Cover Design (§ 9.10). The final cover system requirements contained in HMWMD's landfill regulations (§§ 3.5 and 3.6) are applicable to waste impoundments (§ 9.10). Final cover designs must be either a soil cover or a composite cover (§ 3.5.3). A soil cover must have an infiltration layer consisting of a minimum of 18 inches of earthen material with a permeability equal to or greater than the liner or natural subsoils present or no greater than 1 x 10^{-5}, whichever is less, and an erosion layer of earthen material a minimum of six inches and capable of sustaining native plant growth (§ 3.5.3(A)). Alternative designs, including geocomposite materials, soil admixtures, and polymers, may be approved by CDPHE, if the design will minimize infiltration and erosion, and comply with § 2.1.15 (owner must demonstrate that ground water protection standards will be met at the POC) (§ 3.5.3).

Any settling pond containing treatment solids (solid waste) that is permanently closed will meet the final cover requirements under these regulations.

Q. Colorado Division of Water Resources, State Engineer's Office ("SEO") Dam Safety and Construction Rules and Regulations (2 CCR 402-1). These rules require SEO approval of construction and operation of a "jurisdictional" dam (§ 5). A "jurisdictional dam" is defined as any dam that creates a reservoir with a capacity of more than 100 acre-feet, or creates a reservoir with a surface area in excess of 20 acres at the high-water line, or exceeds 10 feet in height measured vertically from the elevation of the lowest point of the natural surface of the ground where that point occurs along the longitudinal centerline of the dam up to the crest of the emergency spillway of the dam (§ 4.2.5.1).

On October 20, 2010, Atlantic Richfield requested confirmation from SEO that the proposed renovation work on Pond 18 and its embankment does not convert the embankment into a "jurisdictional" dam subject to SEO safety and construction requirements. The SEO provided written confirmation that the Pond 18 embankment remains a non-jurisdictional dam, and approved the proposed modifications. Atlantic

Richfield does not expect that work performed on the other ponds will result in creation of a jurisdictional dam.

R. Institutional Controls (C.R.S. 25-15-320(2)). Environmental covenants must be placed on property addressed under a "environmental remediation project."

To comply with this requirement, NorthRico will record environmental covenants on any of its properties on which closed settling ponds and solids repositories are located.

II. GROUND WATER PROTECTION REQUIREMENTS

A. Interim Standards (§ 41.5(C)(6)). Ground water at the site does not have a classified use (e.g., domestic-use, agriculture, surface water quality protection, or potentially usable quality), and therefore no corresponding numeric standards apply. Site-specific numeric standards have also not been assigned. Therefore, the applicable interim standards are the greater of existing ambient quality as of January 31, 1994, or the MCLs applicable to ground water, set forth in Tables 1 through 4 of the Basic Standard for Ground Water contained in 5 CCR § 1002-41.

Ground water data generated subsequent to January 31, 1994 is presumed to be representative of ground water quality that existed as of January 31, 1994, if the available information indicates that there has been no new or increased ground water contamination initiated in the area in question subsequent to that date. However, the regulation also states that "if available information is not adequate to otherwise determine or estimate existing ambient quality as of January 31, 1994, such ground water quality for each parameter shall be assumed to be no worse than the most stringent levels provided in [the state MCL tables]." § 41.5(C)(6)(b).

Available ground water data for the site subsequent to January 31, 1994 shows no exceedance of an MCL standard for any measured organic constituent. Reported data shows MCL standards for arsenic, cadmium and other inorganic constituents in groundwater are not consistently met in the alluvial aquifer at the site. For purposes of determining site groundwater standards, the presumption is that these sampling results represent ground water quality as it existed on January 31, 1994. Therefore, the applicable ground water standards for the site are the highest levels detected in monitoring of site groundwater for a given inorganic constituent, or the MCL, whichever is higher.

B. Nondegradation of Ground Water. State ground water regulations do not contain specific nondegradation provisions like surface water regulations. However, the regulation notes that where contamination already exists, this interim standard is merely intended to assure that conditions are not allowed to deteriorate further pending remedial action. 41.5(C)(6)(b)(ii).

Seepage from the Class III impoundments (unlined settling ponds) will not further impair or adversely impact ground water within the alluvial aquifer based upon the characteristics of the seepage waters and the operational practices to be followed. See Attachment 2 to the Work Plan.

C. Statewide Organic Pollutant Standards (§ 41.5(C)(3)). Anaiysis of St. Louis Tunnel discharge and pond waters taken in August 1995 did not detect organic compounds, and thus, organic pollutant standards are not applicable.

D. Point of Compliance (§ 41.6). Any "activity" that discharges or causes a discharge of pollutants to ground water, including "pits, ponds, and lagoons used for storage, treatment and/or disposal of pollutants" (§ 41.3(1)), must comply with ground water quality standards at the Point of Compliance ("POC"). Existing discharges are "activities" and are not exempted from this requirement (§ 41.7(l)). "Point of Compliance" is defined under the ground water regulations as a vertical surface located "at some specified distance hydrologically downgradient of the activity being monitored for compliance [in the absence of WQCC establishing an alternative site-specific POC]." (§ 41.3(10)).

The POC is established by the "implementing agency" for those activities under their control. The "implementing agency" responsible in Colorado for regulating solid waste disposal facilities like the pond system is the HMWMD (C.R.S. 25-8-202(7)(a); See *Memorandum of Agreement for Implementation of S.B. 181 Amendments to Colorado Water Quality* Act, July 31, 2008 ["July 31, 2008 MOA"]). For such facilities, HMWMD sets the POC (defined as the site boundary), and applies the applicable water quality standards and classifications, as adopted by WQCC, for protection of ground water (6 CCR 1007-2, §§ 1.2 and 2.0, and July 31, 2008 MOA). As described more fully in Paragraph I.F above, the appropriate POC for this site lies just downstream of existing Pond 1, which is a component of the entire integrated ponds systems. This point lies on the perimeter of the site boundary, and will be located on property owned or controlled by the NorthRico Trust.

III. SURFACE WATER PROTECTION REQUIREMENTS

A. Classifications and Numeric Standards (5 CCR 1002-31 and 1002-34). Surface water quality standards have been established for the mainstem of the Dolores River from its source to its confluence with Horse Creek (Dolores River Basin Stream Segment 2). This specific segment of the Dolores River includes the Rico Mining District watershed and has been assigned the following classified beneficial uses:

- Aquatic Life, Class 1 (Cold Water Aquatic Life): Capable of sustaining a wide variety of cold water biota, including sensitive species, or could sustain such biota but for correctible water quality conditions. Waters are considered capable of sustaining where physical habitat, water flows or levels, and water quality conditions result in no substantial impairment of the abundance and diversity of species.
- Recreation, Class E (Existing Primary Contact Use): Surface waters used for primary contact recreation or has been used for such activities since November 28, 1975.
- Domestic Water Supply: Suitable or intended to become suitable for potable water supplies, and after standard treatment, will meet Colorado drinking water regulations.
- Agriculture: Suitable or intended to become suitable for irrigation of crops grown in Colorado and is not hazardous as drinking water for livestock.

Section 31.3 requires that all classified uses be protected. Based on these classifications, numeric standards have been set for Dolores River Basin Stream Segment 2 for physical/biological, inorganic, and metals parameters, in accordance with the Classifications and Numeric Standards for San Juan and Dolores River Basins (WQCC Regulation 34), and as delineated in the Stream Classification and Water Quality Standards table contained in § 34.6(4). The numeric standards and calculations made applying a specific hardness value also are set forth in the October 29, 2008 Water Quality Assessment ("WQA")). See Attachment 1 of Work Plan. The Table Value Standards for Surface Waters are contained in WQCC Regulation 31. Numeric standards may be exceeded for temporary natural conditions such as unusual precipitation patterns, spring runoff or drought (§ 31.7(1)(b)). Also, when appropriate, achieving water quality standards through innovative solution or management approaches may be implemented through control regulations (§ 31.3).

The treatment technology employed under the proposed plan will meet the effluent limitations determined by CDPHE in accordance with the WQA (as updated) and incorporated into Atlantic Richfield's CDPS discharge permit, at the surface water POC. All classified uses will be protected by operation of the ponds system as proposed. The ponds system uses innovative solutions and approaches to achieve water quality standards for the Dolores River.

B. Temperature Standards (§ 34.5(1)). The temperature of site surface water shall maintain a normal pattern of diurnal and seasonal fluctuations with no abrupt changes and no increase in temperature magnitude, rate and duration deemed deleterious to resident aquatic life. The standard of a 3° C temperature increase above ambient water temperature as defined is generally valid based on the data regarding that temperature necessary to support an "Aquatic Life - Class 1" fishery. Also, effective until December 31, 2011: Segments or portions of segments that are first, second or third order streams above 7000 feet elevation and classified Aquatic Life cold 1 or 2 shall have a chronic temperature standard of 17 °C (MWAT) with no acute standard.

Surface water temperatures of the Dolores River at and downstream of the site are not expected to be impacted by ponds system discharges.

C. Statewide Basic Narrative Standards (§31.11(1)). Except where authorized by permit, BMPs, 401 certifications, or plans of operation approved by the State or another applicable agency, state surface waters must be free from substances attributable to human-caused point source or nonpoint source discharges in amounts, concentrations or combinations that:

- settle to form bottom deposits detrimental to beneficial uses, including anaerobic sludges, mine slurry and tailings, silt, and mud.
- form floating debris, scum or other surface materials sufficient to harm existing beneficial uses;
- produce color, odor or other conditions that create a nuisance or harm existing beneficial uses;
- are harmful to the beneficial uses or toxic to humans, animals, plants, or aquatic life;
- produce predominance of undesirable aquatic life; or
- cause a film on the surface or a deposit on the shoreline.

Discharge of substances regulated by permits that are within the permit limitations shall not be a basis for enforcement proceedings under the above basic standards.

The above basic standards shall be met; the point source discharge from the treatment system outfall to the Dolores River will comply with the effluent limitations adopted for Atlantic Richfield's CDPS discharge permit, all of which will be based on the WQA.

D. Antidegradation (§ 31.8). Because the Dolores River at the site is not designated an "Outstanding Waters" or "Use-Protected Waters," limited degradation of the existing water quality is permissible. However, at a minimum, for all state surface waters, the regulations prohibit water quality degradation that would interfere with or become injurious to the classified uses. Thus, existing classified uses assigned to this segment of the Dolores River, and the level of water quality necessary to protect such uses, must be maintained and protected. The classified uses are deemed protected if the narrative and numerical standards are not exceeded (§ 31.8(1)(c)).

Nondegradation requirements will be addressed through CDPHE's determination of effluent limitations incorporated into a CDPS discharge permit for the treatment system. See Attachment 1 to Work Plan. So long as discharges comply with the permit effluent limits, the ponds system will not degrade surface water quality at or downstream from the site.

E. Salinity and Suspended Solids Standards (§ 31.12). The WQCC has not promulgated standards for salinity or suspended solids that specifically apply to surface waters at the site. However, WQCC Regulation 61 restricts salt discharges from industrial sources to protect the mainstem of the Colorado River, unless the discharge proponent can demonstrate impracticability in preventing salt discharges.

As described more fully in the WQA, discharges from the St. Louis Tunnel consist of ground water that otherwise would occur anyway. Following completion of the Removal Action, monitoring for salinity will occur in accordance with the requirements of the CDPS discharge permit.

F. Discharge Effluent Limitations (§ 31.14). Any point source surface discharges from the ponds system must be authorized pursuant to a CDPS discharge permit obtained pursuant to the Colorado Water Quality Control Act (C.R.S. § 25-8-101 et seq.) and 5 CCR 1002-61 § 61.3(a)(1). Under § 31.14, where effluent limitations regulations applicable to discharges into a state surface water are adequate to maintain or attain the assigned classifications and standards, only the effluent limitation regulations will control the discharges (i.e., "effluent limited" waters). However, where such effluent limitation regulations are not adequate, a degree of treatment that will maintain or attach such classifications and standards will be required (i.e., "water quality limited" waters). Section 31.14(5) also provides that when proposed by a discharger, innovative solutions or management approaches may be used to achieve and maintain water quality standards and integrated into discharge permits where appropriate.

Effluent limitations will be established by CDPHE in Atlantic Richfield's CDPS discharge permit based on the WQA. Treated effluent discharged from the ponds system, after lime addition treatment and settling of solids, will be adequate in quality to maintain the assigned classifications and standards for the Dolores River at and downstream of the site.

G. Mixing Zones (§ 31.10). The regulations allow for mixing zones to exempt water quality-based effluent discharges from permit limits, or to set permit limits. An exceedance zone is a part of the physical mixing zone in which numeric water quality standards (acute and chronic) for a given parameter are not met. The size of the acute and chronic mixing zones are related to size of the receiving water. CDPHE has discretion to limit mixing zones on a site-specific basis based on several factors, including potential for human exposure to pollutants through drinking water or recreation, and potential for adverse effects on ground water (§ 31.10(5)).

A mixing zone as the point of discharge for the ponds system will be considered by the CDPHE as part of the review and approval of the pending CDPS discharge permit application filed by Atlantic Richfield. A prior mixing zone analysis confirmed the ponds system discharge qualifies for exemption from mixing zone restrictions.

IV. LOCAL REQUIREMENTS

A. Dolores County Development and Land Use Regulation. Dolores County has adopted a comprehensive land use and development regulation applicable to activities conducted on unincorporated County land.

To obtain a COD from Dolores County for the solids repository, Atlantic Richfield must enter into a Land Development Agreement with Dolores County, under which Atlantic Richfield commits to construct and operate the solids repository in satisfaction of performance standards imposed by the County for the COD. Atlantic Richfield will comply with all applicable County development and land use requirements.

B. Town of Rico Regulations. The Town has adopted a comprehensive land use code applicable to any proposed development and land use with the Town's boundaries. In addition, C.R.S. § 31-15-707 grants Colorado home-rule municipalities the authority to adopt local regulations to protect town drinking water supplies by restricting activities performed within the drinking water supply watershed, including any portion of the watershed located outside of municipal corporate boundaries. Pursuant to this statutory authority, the Town of Rico enacted Ordinance 2008-4 creating a watershed protection district and regulating activities within such district that may adversely impact the drinking water supply watershed.

The St. Louis Tunnel water treatment system and all related components and facilities are located in unincorporated Dolores County. The water treatment system, therefore, is not presently subject to Town zoning and other land use regulations. The St. Louis Tunnel water treatment system, including the Tunnel and ponds, are not located within the boundaries of the Town's watershed district and drinking water supply watershed. Thus, the water treatment system is not subject to such ordinance.

APPENDIX C
MICROPROBE RESULTS

Sample **EB-1 (22-24)**

Sample is dominated by iron oxide, with abundant quartz, calcite, microcline and gypsum. Iron-poor clay is also found in minor amounts. Sphalerite, pyrite and galena are the dominant opaque minerals. Minor zinc and copper sulfate are observed.

Sources of:

Mn: sphalerite, calcite, clay
Cd: sphalerite
Cu: copper sulfate

Sample **EB-1 (18-20)**

Sample is dominated by iron oxide, with abundant quartz, calcite, microcline and gypsum. Sphalerite and galena are the dominant opaque minerals. Minor zinc and copper sulfate and jarosite are observed.

Sources of:

Mn: sphalerite, iron oxides
Cd: sphalerite
Cu: copper sulfate

Sample **EB-2 (7-9)**

Sample is dominated by iron oxide and microcline with some quartz and gypsum. Galena is the dominant opaque mineral. Very minor sphalerite and calcite.

Sources of:

Mn: sphalerite
Cd: sphalerite
Cu: ??

Sample **EB-1 (10-12)**

Sample is dominated by iron oxide and microcline with some quartz. Galena and sphalerite are the dominant opaque minerals. No gypsum was observed.

Sources of:

Mn: sphalerite
Cd: sphalerite
Cu: ??

Sample **EB-2 (5-7)**

Sample is dominated by iron oxide and microcline with some quartz. Galena and sphalerite are the dominant opaque minerals but not very abundant. Minor gypsum was observed.

Sources of:

Mn: sphalerite
Cd: sphalerite
Cu: ??

APPENDIX D
GROUNDWATER QUALITY DATA

Table D1
Groundwater Quality Data Summary
(all concentrations in mg/L)

Date	GW-1		GW-2		GW-3		GW-4		GW-5		GW-6		GW-7		GW-8	
Cadmium (dissolved)																
October 2002	0.002	U	0.002	U	0.002	U	0.002	U	0.002	U	0.015		0.007		0.002	
November 2004	0.0002	B					0.0011		0.0033		0.0004	U	0.009		0.0017	B
May 2005	0.0001	B	0.0015		0.0041		0.0001	U	0.0001	U			0.0373		0.0001	B
August 2005	0.0005	U	0.0012	B	0.0011	B	0.0001	U	0.0005	U	0.0005	U	0.0109		0.0002	U
January 2006	0.0001	U			0.001		0.0001	U	0.0005	U			0.0106		0.0001	B
July 2006	0.0001	U			0.0007		0.0001	U					0.0031		0.001	U
January 2007	0.0001	U			0.0004	B	0.0001	U	0.0001	U	0.0001	U	0.006		0.0001	U
Iron (dissolved)																
October 2002	0.16		1.1		0.095		0.3		4.6		630		0.18		41	
November 2004	0.07						0.23		1.42		8.79		2.78		178	
May 2005	0.01	U	0.22		0.01	B	0.45		1.92				1.31		7.09	
August 2005	0.02	U	0.15		0.02	U	0.36		7.57		151		0.13		15.3	
January 2006	0.11				0.02	B	1.24		3.44				9.09		21.9	
July 2006	0.02	U			0.02	B	22.3						0.09		22.3	
January 2007	0.02	U			0.02	U	0.28		3.95		153		8.79		18.3	
Manganese (dissolved)																
October 2002	0.0005	U	2.8		0.43		1.7		4.7		42		0.84		8.1	
November 2004	0.121						0.591		4.38		7.32		2.42		25.4	
May 2005	0.005	U	12.2		0.496		0.7		6.27				2.33		5.24	
August 2005	0.005	U	5.99		0.015	B	0.624		7.85		14.1		0.774		6.13	
January 2006	7.1				16.5		24.8		37.6				39.3		53.5	
July 2006	0.005	U			0.271		7.38						0.866		7.38	
January 2007	0.005	U	0.226		0.568		3.79		20.2		19.2		1.83		6.85	
Zinc (dissolved)																
October 2002	0.012		0.064		0.38		0.073		7.1		4.7		0.67		0.22	
November 2004	0.01	U					0.05	B	7.75		0.23		2.23		9.44	
May 2005	0.01	U	0.22		0.78		0.02	B	17.3				6.51		0.18	
August 2005	0.01	U	0.07		0.31		0.03	B	30.3		17.7		1.83		0.22	
January 2006	0.009	B			0.127		0.505		3.51				2.01		6.45	
July 2006	0.01	U			0.09		0.16						0.44		0.16	
January 2007	0.01	U			0.11		0.01	B	6.29		14.6		1.43		0.17	

U = undetected B= below practical quantiation level

Table D2
Minimum and Maximum Groundwater Concentrations
(all concentrations in mg/L)

Parameter	Analyte Type	GW-1		GW-2		GW-3		GW-4		GW-5		GW-6		GW-7		GW-8	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Alkalinity	Total	90	152	216	243	87	192	68	197	96	156	32	150	30	269	4	212
Arsenic	Dissolved	0.0001	0.017	0.001	0.017	0.0005	0.017	0.0004	0.0922	0.015	0.054	0.017	0.291	0.0003	0.017	0.0071	0.22
Arsenic	Total	0.0005	0.0378	0.0012	0.003	0.0005	0.0139	0.0011	0.213	0.071	0.152	0.174	0.429	0.0005	0.016	0.141	0.213
Barium	Total	0.058	0.058	0.067	0.067	0.017	0.017	0.039	0.039	0.019	0.019	0.033	0.033	0.015	0.015	0.03	0.03
Bicarbonate	Unknown	90	152	216	243	87	192	68	197	96	156	32	150	30	269	4	212
Cadmium	Dissolved	0.0001	0.002	0.0012	0.002	0.0007	0.0041	0.0001	0.002	0.0001	0.0033	0.0004	0.015	0.0031	0.0373	0.0001	0.002
Cadmium	Total	0.0001	0.0086	0.0013	0.0016	0.0013	0.0042	0.0001	0.0037	0.0002	0.0369	0.0003	0.0018	0.0036	0.0393	0.0002	0.0045
Calcium	Dissolved	48.2	82.7	215	351	156	224	224	505	573	632	502	502	271	404	405	505
Carbonate	Unknown	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Chloride	Total	0.5	1.3	1.2	2	0.5	5	0	10	0	0.8	0	0.5	0	5	0	5
Chromium	Dissolved	0.0001	0.0005	0.0002	0.0005	0.0001	0.0005	0.0001	0.0005	0.0001	0.0005	0.0005	0.0005	0.0001	0.0002	0.0001	0.001
Chromium	Total	0.0002	0.147	0.0005	0.003	0.0002	0.0015	0.0001	0.0043	0.0003	0.0092	0.0011	0.0011	0.0002	0.0014	0.0002	0.0073
Copper	Dissolved	0.0005	0.003	0.0012	0.004	0.0009	0.003	0.0005	0.0074	0.0005	0.023	0.001	0.005	0.0012	0.0309	0.0005	0.003
Copper	Total	0.0006	0.3	0.0099	0.01	0.003	0.0057	0.0005	0.0099	0.002	0.657	0.009	0.016	0.0041	0.033	0.001	0.043
Cyanide	Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyanide	Unknown	0.005	0.005	0.005	0.005	0	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0	0.005
Dissolved Oxygen	Dissolved	0.004	0.73	0	0	0	0	0.0043	0.02	0.001	0.001	0.00097	0.00097	0.00065	0.46	0.0015	0.05
Hardness	Total	146	248	642	1030	458	678	662	1500	1610	1740	1490	1540	820	1260	1200	1630
Hydroxide	Unknown	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Iron	Dissolved	0.01	0.16	0.15	1.1	0.01	0.095	0.23	22.3	1.42	7.57	8.79	630	0.09	9.09	7.09	178
Iron	Total Recoverable	0.05	0.16	0.93	2.14	0.02	0.99	1.6	32.8	6.54	46.1	33.9	168	0.48	14.8	17.5	245
Lead	Dissolved	0.0001	0.014	0.003	0.014	0.0001	0.014	0.0001	0.014	0.0005	0.138	0.0131	0.041	0.0033	0.0293	0.0003	0.048
Lead	Total	0.0001	0.524	0.008	0.0206	0.0005	0.0193	0.0001	0.0871	0.0015	4.43	0.136	0.194	0.0125	0.11	0.0042	0.632
Magnesium	Dissolved	6.2	10	25.5	37.6	16.5	28.8	24.8	58.1	37.6	51.5	56.5	70	34.6	61.4	44.5	126
Manganese	Dissolved	0.0005	0.121	2.8	12.2	0.015	0.496	0.505	7.38	3.51	7.85	7.32	42	0.774	2.42	5.24	25.4
Manganese	Total Recoverable	0.005	48.8	6.22	13.1	0.38	0.965	0.532	6.79	3.51	9.04	7.09	15.2	0.792	2.68	5.08	24.3
Mercury	Dissolved	0.00003	0.0002	0.00003	0.0002	0.00003	0.0004	0.00003	0.0002	0.00003	0.0002	0.00003	0.0002	0.00003	0.0038	0.00003	0.2
Nickel	Dissolved	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.05	0.46	0.01	0.05	0.0006	0.08
Nickel	Total	0.01	0.86	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.02	0.05	0.01	0.05	0.0006	0.02
Potassium	Dissolved	0.7	1.7	12.2	16.7	2.7	4.4	1.9	8.4	5.4	6	8.2	25.7	1.9	2.7	6.2	23.5
Selenium	Dissolved	0.0003	0.0007	0.0001	0.0002	0.0005	0.002	0.0001	0.0005	0.0001	0.0006	0.0002	0.0002	0.0004	0.0007	0.0001	0.0005
Selenium	Total	0.0003	0.001	0.0001	0.0001	0.0004	0.0018	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0003	0.0008	0.0001	0.0005
Silver	Dissolved	0.00005	0.0003	0.0001	0.0003	0.00005	0.0003	0.00005	0.00005	0.00005	0.0003	0.0002	0.0003	0.00005	0.0001	0.00005	0.0002
Silver	Total	0.00005	0.00288	0.00017	0.0007	0.00005	0.0003	0.00005	0.0003	0.0001	0.0167	0.0001	0.0006	0.0001	0.00037	0.0001	0.0017
Sodium	Dissolved	2	4.4	7.9	13.1	3.8	5.7	9.6	11.7	11.2	15	4.2	11.6	6.7	10.3	10.3	10.9
Sulfate	Total	46.9	63.7	534	870	294	555	469	1180	1220	1580	1050	1910	542	1230	880	1190
TDS	Total	170	230	1060	1520	520	920	970	1950	2250	2550	2080	3170	1060	1960	1580	2910
TDS Calc.	Dissolved	160	200	932	1450	586	877	901	1910	2160	2330	2710	2710	1050	1730	1490	1950

Table D2 (continued)
Minimum and Maximum Groundwater Concentrations
(all concentrations in mg/L)

Parameter	Analyte Type	GW-1		GW-2		GW-3		GW-4		GW-5		GW-6		GW-7		GW-8	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
TSS	Total	0	103000	6	20	0	26	6	56	5	472	16	82	5	104	5	224
Zinc	Dissolved	0.01	0.012	0.064	0.22	0.09	0.78	0.02	0.16	6.32	30.3	0.23	17.7	0.44	6.51	0.16	9.44
Zinc	Total	0.01	7.14	0.11	0.24	0.14	0.74	0.02	0.29	6.51	36.3	0.39	19.9	0.48	6.59	0.19	9.51

Table D3

Groundwater Quality Data Summary

Dissolved Concentrations in µg/l (except as noted otherwise)

Parameter (Date Sampled)	DWCD Test Well (8/5/2003)	RA-GW-01 (USFS Well) (1996)	GW1 (10/2003)	GW2 (10/2003)	GW3 (10/2003)	GW4 (10/2003)	GW5 (10/2003)	GW6 (10/2003)	GW7 (10/2003)	GW8 (10/2003)	by URS Start2					
											RA-GW-02 Total (10/2003)	RA-GW-02 Dissolved	RA-GW-03* Total (10/2003)	RA-GW-03* Dissolved	RA-GW-04* Total (10/2003)	RA-GW-04* Dissolved
pH	7.05		7.4	7.3	6.4	7.2	6.9	6.4	6.5	6.5	7.67		6.44		7.44	
TDS	466,000										0.14		1.52		1.51	
Conductivity											0.29		3.05		3.02	
Temp Deg F			51.8	53.4	51.6	56.7	56.5	55.4	60.1	55.4	46.1		109.9		102.6	
Alkalinity	362,000															
Aluminum		8.0U									200U	200U	200U	200U	200U	200U
Antimony	U	3.0U									20U	20U	20U	20U	20U	20U
Arsenic	U	2.0U	17U	17U	17U	17U	17U	17U	17U	220	10U	10U	37	37	25	25
Barium	53	32.4B	58J	67J	17J	39J	19J	33J	15J	30J	130	130	100U	100U	100U	100U
Beryllium	U	1.0U									5U	5U	5.6	5.6	5U	5.4
Cadmium	U	1.0U	2U	2U	2U	2U	2U	15	7	2U	5U	5U	5U	5U	5U	5U
Calcium		76,600									52000	53000	670000	680000	700000	700000
Chromium	U	1.0U									10U	10U	10U	10U	10U	10U
Cobalt	U	1.1B									10U	10U	10U	10U	10U	10U
Copper	U	4.0U	1.2U	1.2U	1.2U	1.2U	1.2U	5	1.2U	1.2U	170	14	10U	10U	10U	10U
Cyanide	U										10U	N/A	10UJ	N/A	10UJ	N/A
Flouride	U															
Iron		10.0U	160	1,100	95	2,300	4,600	630,000J	180	41,000	140J	100UJ	7600J	7200J	5900J	6900J
Lead	U	1.0U	14U	14U	14U	14U	14U	14U	14U	14U	5.4	3	6U	6U	6U	6U
Magnesium		5,750									9100	9400	88000	90000	81000	82000
Manganese		2.3B	0.5U	2,800	430	1,700	4,700	42,000	840	8,100	12	10U	1,000	1,000	1300	1300
Mercury	U	0.20U	0.03U	0.03U	0.03U	0.03U	0.03U	0.03U	0.03U	0.03U	0.2U	0.2U	0.2U	0.2U	0.2U	0.2U
Nickel	U	1.0U									20U	20U	20U	20U	20U	20U
Potassium		4,680B									1000U	1100	27000	29000	26000	26000
Selenium	U	2.0U									5U	5U	5U	5U	5U	5U
Silver		1.0U									10U	10U	10U	10U	10U	10U
Sodium	7,600	2,250B									1200	1100	60000	62000	60000	59000
Sulfate	61,000															
Thallium	U	2.0U									10U	10U	10U	10U	10U	10U
Vanadium		1.0U									10U	10U	10U	10U	10U	10U
Zinc		76.2	12J	64J	380J	73J	7,100J	4,700J	670J	220J	90	20U	87	87	41	42

B - The associated numerical value was detected below the CRDL, but greater than the method detection limit and Is therefore

J - The associated numerical value is an estimated quantity because the Quality Control criteria were not met

U - The analyte was not detected at reported concentration (qualified by laboratory software). -or- The material was analyzed for,

APPENDIX E
RESPONSES TO EPA COMMENTS

Responses to EPA Comments[1]

on

Initial Solids Removal Plan Submitted May 2, 2011

by

Atlantic Richfield Company

July 7, 2011

SOLIDS REMOVAL PLAN (SRP)

COMMENT: As was discussed during our meeting in Denver on May 10, several elements of the solids management operation are conceptual at this time, and we understand that the plan proposes to obtain additional information during 2011 in order to develop final designs. However, some information already exists that would be useful in this document to support the initial decision to allow placement of the drying facility on the calcine tailings. The physical and chemical properties of the calcine tailings should be provided in this document based on historical data collection. Specific plans to collect data that will answer these questions must be explained also. These data should address the questions as whether the tailings can support the drying facility and that the flow of leachate through the tailings will not degrade downgradient groundwater or surface water quality. Please address these comments and those that follow in the revised SRP.

RESPONSE: See additional discussion of a site geologic and groundwater model for the proposed interim drying facility in Section 3.2 and a discussion of the calcine tailings and proposed geochemical sampling and testing in Section 3.3 of the revised Initial Solids Removal Plan (ISRP) dated June 30, 2011.

COMMENT: The depiction in this draft plan of the water level relative to the bottom of the proposed drying cells raises concerns, and it is of interest and should be monitored. It is understood that the water level data shown was projected from wells not in the immediate area.

RESPONSE: See discussion of groundwater levels and conditions in Section 3.2 and Section 3.3 of the revised Initial Solids Removal Plan (ISRP) dated June 30, 2011.

[1] EPA Comments on Atlantic Richfield Submittals May 2, 2011: Sampling and Analysis Plan/Quality Assurance Project Plan/Solids Management Plan and Health and Safety Plan: transmitted via email from Steve Way/EPA to Chuck Stilwell/Atlantic Richfield on May 27, 2011 at 2:58 pm MDT.

COMMENT: Additionally, it is expected that details of the planned sampling and geotechnical analyses of the solids for purposes of design the repository and associated placement requirements will be forthcoming in a separate submittal.

RESPONSE: Comment noted and agreed to.

COMMENT: The plan submitted May 2, 2011 proposes to construct an "Interim Drying Facility" with multiple cells of varied design in a location above the water table to promote gravity drainage. An allowance for decanting water to the side of the cells is also included in case the gravity drainage concept is ineffective. The solids materials (mostly lime sludge precipitates) are estimated to have a permeability of around 1 x 10^{-5} cm/sec. Initially solids will be removed from pond 18 which has been subject to surface drying and some consolidation during dry seasons and by purposefully routing flow away from the pond to promote drying. The plan proposes that various methods of excavation and removal may be attempted including front end loader or low ground pressure long-stick excavators feeding haul trucks, and hydraulic suction dredges feeding pumped sludge pipeline system. The following comments are offered:

1. The proposed location of the drying cells above the existing water table is the most logical choice and is recommended to proceed to construction.

   RESPONSE: Comment noted.

2. What is the detail for the run on control ditch? Will the ditch be lined or will the uphill side of the embankments be constructed from low permeability fill to minimize the infiltration of ditch flow seepage into the drying cells?

   RESPONSE: The run-on control ditch/berm will be constructed of sufficiently low permeability soils and with adequate grade and freeboard to minimize surface water inflow or infiltration to the drying cells. The design of the system will be based on engineering judgment and the experience of the Atlantic Richfield design and construction oversight team.

3. Front end loaders are likely to be ineffective due to their limited reach and are liable to become stuck in the mud because of the high bearing pressure of the tires and are therefore not recommended for this work. Building earthen causeways or placing swamp mats is very time consuming and should be avoided if possible.

   RESPONSE: Comment noted.

4. It is not understood why a two-feet-thick layer of solids must remain in pond 18 as a "liner." If this layer could be eliminated (allowing excavation to a firm foundation) than the need for a low ground pressure excavator could be eliminated in favor of a more conventional excavator. A long-stick is recommended as the greater reach is very useful in projects of this nature and provides for a safer working environment by keeping the

machine away from the active excavation face which is prone to break off and slide without warning.

RESPONSE: It is Atlantic Richfield's intention to maintain a nominal thickness of relatively low permeability settled solids in the bottoms, and to the extent practical, on the side slopes, of the ponds during removal of solids to retain the option of further analyzing the need for and effectiveness of these materials in reducing seepage of pond water to the underlying typically coarse-grained alluvial aquifer. The additional evaluation of the pond bottom design will be performed as part of the upcoming water treatment technology screening and design tasks.

5. An initial test of stacking the material should be made in pond 18. If it is possible to dig and stack the material, to say 4 to 8 feet high along the side of the pond and let it stand for a day or two, a significant initial dewatering may occur. This extra effort can reduce the volume hauled out of the pond and speed subsequent drying and handling operations. The strength of the material can be quickly judged in the field by seeing how high an excavator can pile it up until the pile has a slope failure.

   RESPONSE: The suggested stacking of pond solids as described is judged not feasible based on prior experience at Rico and other Atlantic Richfield sites with similar lime-precipitated settled solids.

6. Drying in place in the cells is all that is proposed for the test and the material will be left in place over the winter. It is recommended that if drying in the cells is successful, further processing such as compaction in place or removal and compaction in one of the other cells be performed to take advantage of dry fall weather. Experience at several other similar projects has shown that the dry weather is a limiting factor to drying and consolidation and full advantage should always be taken of this seasonal benefit to reduce the material volume (even for a test operation).

   RESPONSE: Consideration will be given to this suggestion based on the measured and monitored performance of the test cells as proposed in the ISRP. This information will be used as part of the geotechnical evaluation and design of the solids repository.

7. Wet sloppy material tends to slosh around and spill out of trucks. Consider the geometry of the haul truck beds before making a selection as some are better able to carry runny material.

   RESPONSE: Comment noted.

8. No consideration of admixtures is included in the tests. Were they considered? We note the following results in dealing with sludge:

Admixture	Comments
Dry granular soil, gravel, or waste rock.	Dry soil can absorb water and increase strength. It has the disadvantage of significantly increasing disposal volume and requires an on-site borrow source to be cost effective as the additions are in the 20 to 35% range.
Cement	Excellent in adsorbing water and improving strength of very weak material. Increases disposal volume slightly. Usually a few bench scale mixing tests are performed to determine the amount of cement addition.
Fly ash or lime	Absorbs water and improves strength, to be cost effective a low-cost source would need to be identified.

RESPONSE: The decision as to whether or not to consider amendments will be based on the measured and monitored performance of the test cells as proposed in the ISRP.

9. Proposed drying cell 3 (placing runny material on a clean gravel without a filter is not recommended. The sludge is likely to migrate into the gravel and eventually clog it thus creating a larger disposal volume. Consider instead performing a test using either a "dirty gravel" (one that meets filter criteria, or cover the gravel with a thin (8 or 10 oz) non-woven geotextile which has a fairly large opening size (AOS not smaller than 100).

   RESPONSE: It is Atlantic Richfield's intention to construct drying cell 3 as described in the originally submitted ISRP in order to evaluate the nature and degree of intrusion of solids into a gravel drainage media, and the impact of that intrusion on the effectiveness of the gravel drain (even if partially clogged) to effectively convey pore water released by gravity drainage of the overlying treatment solids. The performance of this unfiltered cell will be compared with the performance of the similar but filtered drying cell 4.

10. It appears that pond 18 has denser and more consolidated material than some of the other ponds. The proposed cell placements should be targeted to the consistency of the specific material to be placed. Proposed cells 1 and 2 are only likely to be useful for sludge which can be loaded into trucks. For very watery material where dredging may be the only practical option for transport, the ponds with a designed bottom drain/filter are more appropriate. A few minutes of digging with an excavator and trying to load the material is a quick and easy way to judge if the sludge should be excavated and put into trucks or if it should be dredged. Where the volumes of material to be dredged are small, a super sucker truck has been more cost effective than a dredge feeding a pump and pipeline.

    RESPONSE: Comment noted.

11. Where feasible, excavation and truck hauling should be the favored handling method. Experience on several jobs has shown that this can be accomplished at lower costs (about 1/3 the cost per cubic yard of pumping) and in less time than a dredging, pumping, and drying operation.

RESPONSE: Comment noted.